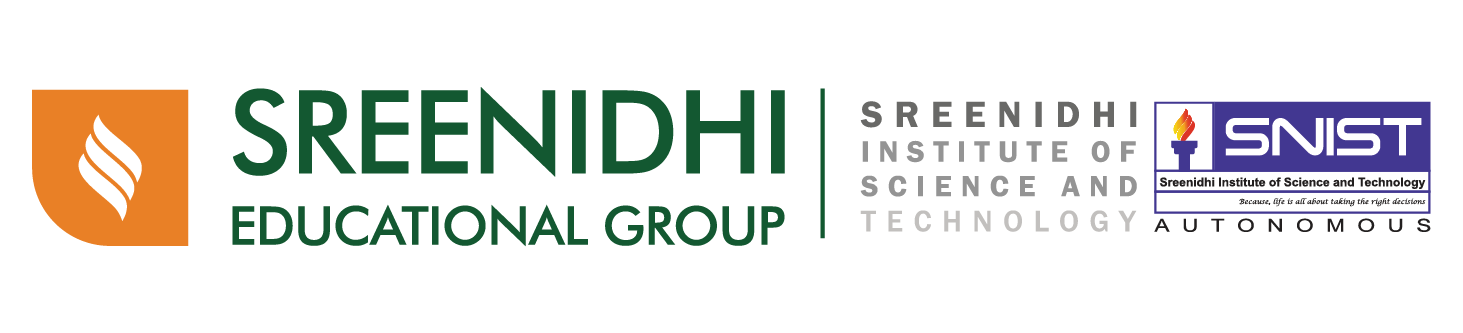
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**COURSE STRUTURE**

**AND**

**SYLLABUS**

For

B.Tech. Four Years Degree Course

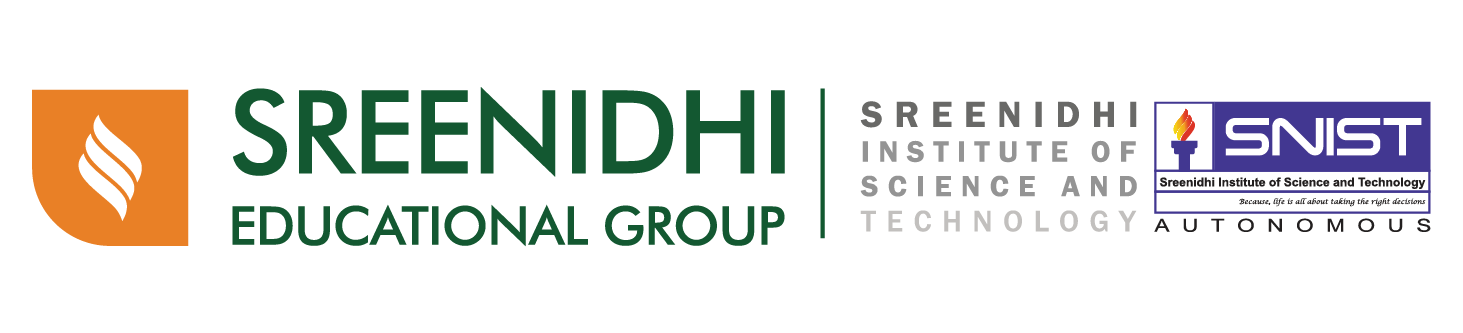
In

**MECHANICAL ENGINEERING**

**(ME)**

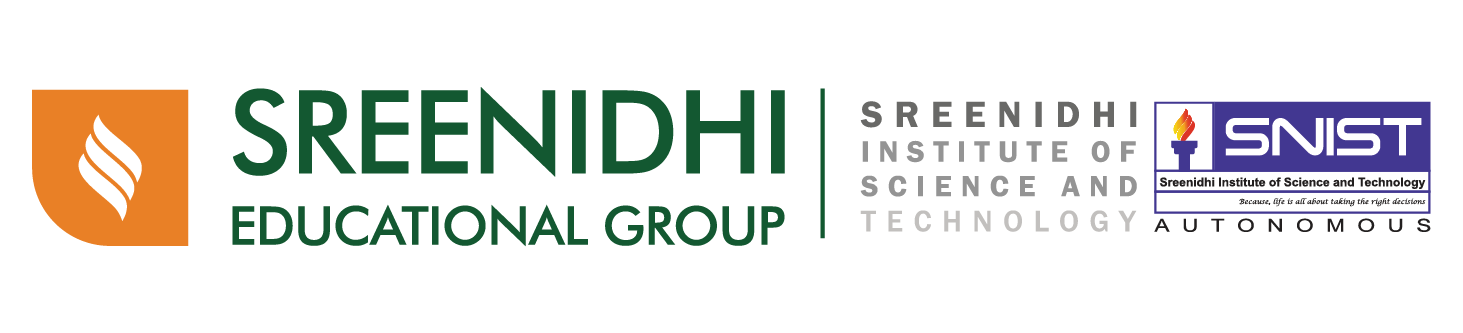
(A22 – III & IV Year)

(Applicable for the batches admitted from AY 2022-23)

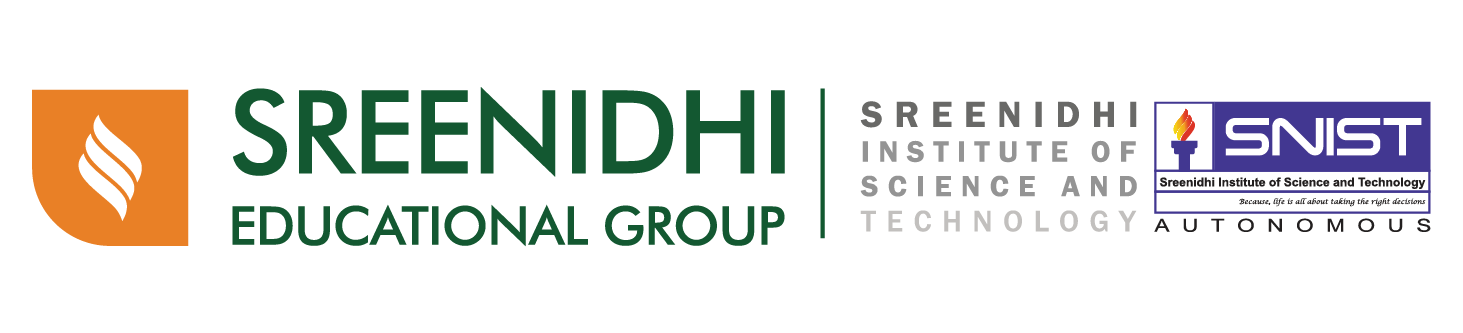


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|  | **A22-Course Structure for B. Tech(Mechanical)-I Year – I semester (1st Semester)** | | | | | | | | | | | | |
| **Sl.No** | **Course code** | | **Name of the Course** | | | **L** | | **T** | **P/D** | | **C** | **Max. Marks** | |
|  |  | |  | | |  | |  |  | |  | **CIE** | **SEE** |
| 1 | 9HC06 | | Applied Physics | | | 2 | | 1 | 0 | | 3 | 40 | 60 |
| 2 | 9HC11 | | Matrix Algebra and Calculus | | | 2 | | 1 | 0 | | 3 | 40 | 60 |
| 3 | 9BC01 | | Engineering Graphics | | | 1 | | 0 | 4 | | 3 | 40 | 60 |
| 4 | 9FC01 | | Problem Solving using C | | | 3 | | 0 | 0 | | 3 | 40 | 60 |
| 5 | 9HC01 | | Essential English Language Skills | | | 2 | | 0 | 0 | | 2 | 40 | 60 |
| 6 | 9HC61 | | Oral communications Lab – I | | | 0 | | 0 | 2 | | 1 | 40 | 60 |
| 7 | 9HC65 | | Applied Physics Lab | | | 0 | | 0 | 3 | | 1.5 | 40 | 60 |
| 8 | 9FC61 | | Problem Solving using C Lab | | | 0 | | 0 | 3 | | 1.5 | 40 | 60 |
| 9 |  | | Induction Program | | |  | |  |  | |  | Satisfactory/Not Satisfactory | |
|  |  | | **Total** | | | **10** | | **2** | **12** | | **18** | **320** | **480** |
|  | | **A22-Course Structure for B. Tech.(Mech.)-I Year – II semester (2nd Semester)** | | | | | | | | | | | |
| **Sl.No** | | **Course code** | | **Name of the Course** | **L** | | **T** | | | **P/D** | **C** | **Max. Marks** | |
|  | |  | |  |  | |  | | |  |  | **CIE** | **SEE** |
| 1 | | 9HC04 | | Engineering Chemistry | 2 | | 1 | | | 0 | 3 | 40 | 60 |
| 2 | | 9HC12 | | Advanced Calculus | 2 | | 1 | | | 0 | 3 | 40 | 60 |
| 3 | | 9EC01 | | Data Structures | 3 | | 0 | | | 0 | 3 | 40 | 60 |
| 4 | | 9HC62 | | Oral communications Lab – II | 0 | | 0 | | | 3 | 1.5 | 40 | 60 |
| 5 | | 9BC02 | | Engineering Mechanics | 2 | | 1 | | | 0 | 3 | 40 | 60 |
| 6 | | 9BC61 | | \*Workshop/ Manufacturing processes Lab | 0 | | 1 | | | 3 | 2.5 | 40 | 60 |
| 7 | | 9HC64 | | Engineering Chemistry Lab | 0 | | 0 | | | 3 | 1.5 | 40 | 60 |
| 8 | | 9EC61 | | Data Structures using C Lab | 0 | | 0 | | | 3 | 1.5 | 40 | 60 |
|  | |  | | **Total** | **9** | | **4** | | | **12** | **19** | **320** | **480** |

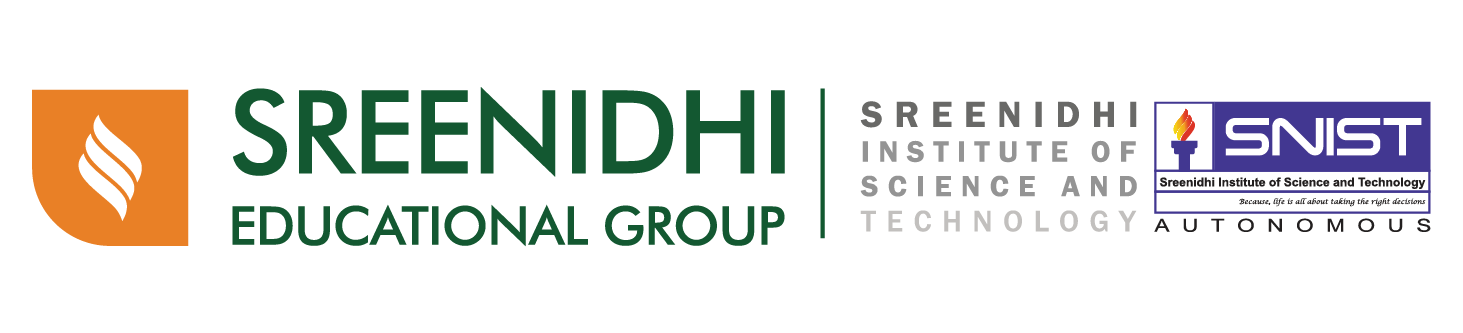
\*Only Laboratory Exam



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|  | **A22- Course Structure for B. Tech.(Mech)-II Year – I semester (3rd Semester)** | | | | | | | | | | |
| **Sl.No** | **Course code** | **Name of the Course** | | **L** | | **T** | **P/D** | **C** | | **Max. Marks** | |
|  |  |  | |  | |  |  |  | | **CIE** | **SEE** |
| 1 | 9ZC01 | Business Economics and Financial Accountancy | | 3 | | 0 | 0 | 3 | | 40 | 60 |
| 2 | 9HC13 | Complex Variable and Statistics | | 2 | | 1 | 0 | 3 | | 40 | 60 |
| 3 | 9EC41 | JAVA programming | | 3 | | 0 | 0 | 3 | | 40 | 60 |
| 4 | 9B303 | Thermodynamics | | 2 | | 1 | 0 | 3 | | 40 | 60 |
| 5 | 9B304 | Metallurgy and Material science | | 2 | | 0 | 0 | 2 | | 40 | 60 |
| 6 | 9B305 | Mechanics of Solids | | 2 | | 1 | 0 | 3 | | 40 | 60 |
| 7 | 9HC63 | Soft skills Lab | | 0 | | 1 | 2 | 2 | | 40 | 60 |
| 8 | 9B362 | Metallurgy Lab | | 0 | | 0 | 3 | 1.5 | | 40 | 60 |
| 9 | 9B363 | Mechanics of Solids Lab | | 0 | | 0 | 3 | 1.5 | | 40 | 60 |
| 10 | 9B364 | Fuels and Lubricants Lab | | 0 | | 0 | 3 | 1.5 | | 40 | 60 |
|  |  | **Total** | | **15** | | **3** | **11** | **23.5** | | **400** | **600** |
|  | **A22- Course Structure for B. Tech.(Mech) -II Year – II Semester( 4th Semester)** | | | | | | | | | | |
| **Sl.No** | **Course code** | | **Name of the Course** | | **L** | **T** | **P/D** | | **C** | **Max. Marks** | |
|  |  | |  | |  |  |  | |  | **CIE** | **SEE** |
| 1 | 9HC05 | | Environmental Science | | 3 | 0 | 0 | | 0 | Satisfactory/Not Satisfactory | |
| 2 | 9AC48 | | Basics of Electrical & Electronics Engineering | | 3 | 0 | 0 | | 3 | 40 | 60 |
| 3 | 9B406 | | Manufacturing Processes | | 3 | 0 | 0 | | 3 | 40 | 60 |
| 4 | 9B407 | | Fluid Mechanics and Hydraulic Machinery | | 2 | 1 | 0 | | 3 | 40 | 60 |
| 5 | 9B408 | | Applied Thermodynamics -I | | 2 | 1 | 0 | | 3 | 40 | 60 |
| 6 | 9HC16 | | Quantitative Aptitude and Logical Reasoning | | 3 | 0 | 0 | | 3 | 40 | 60 |
| 7 | 9AC96 | | Basic Electrical & Electronics lab | | 0 | 0 | 3 | | 1.5 | 40 | 60 |
| 8 | 9B465 | | Manufacturing Processes Lab | | 0 | 0 | 3 | | 1.5 | 40 | 60 |
| 9 | 9B466 | | Fluid Mechanics and Hydraulic Machinery Lab | | 0 | 0 | 3 | | 1.5 | 40 | 60 |
| 10 | 9B467 | | Technical Seminar | | 0 | 1 | 0 | | 1 | 100 | -- |
|  |  | | Summer Industry Internship – I (Evaluation in III-I) | |  |  |  | |  |  |  |
|  |  | |  | | **16** | **3** | **9** | | **20.5** | **360** | **540** |



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|  | **A22-Course Structure for B. Tech.(Mech.)-III Year – I Semester (5th Semester)** | | | | | | | | | | | | |
| **Sl.No** | **Course code** | **Name of the Course** | | **L** | | | **T** | **P/D** | | **C** | | **Max. Marks** | |
|  |  |  | |  | | |  |  | |  | | **CIE** | **SEE** |
| 1 | 9B509 | Applied Thermodynamics-II | | 2 | | | 1 | 0 | | 3 | | 40 | 60 |
| 2 | 9B510 | Kinematics Machinery | | 2 | | | 1 | 0 | | 3 | | 40 | 60 |
| 3 | 9B511 | Metal Cutting & Machine Tools | | 3 | | | 0 | 0 | | 3 | | 40 | 60 |
| 4 | 9B512 | Design of Machine Elements | | 2 | | | 1 | 0 | | 3 | | 40 | 60 |
| 5 | 9B513 | Computer Aided Machine Drawing | | 1 | | | 0 | 4 | | 3 | | 40 | 60 |
| 6 |  | Professional Elective-I | | 3 | | | 0 | 0 | | 3 | | 40 | 60 |
| 7 |  | Cyber Security  (Grade Award) | | 3 | | | 0 | 0 | | 0 | | Satisfactory/Not Satisfactory | |
| 8 | 9B568 | Applied Thermodynamics Lab | | 0 | | | 0 | 2 | | 1 | | 40 | 60 |
| 9 | 9B569 | Machine Tools Lab | | 0 | | | 0 | 2 | | 1 | | 40 | 60 |
| 10 | 9B570 | Summer Industry Internship-I | | 0 | | | 0 | 2 | | 1 | | 40 | 60 |
|  |  | **Total** | | **16** | | | **3** | **12** | | **21** | | **360** | **540** |
|  | **A22-Course Structure for B. Tech.(Mech.)-III Year – II Semester (6th Semester)** | | | | | | | | | | | | |
| **Sl.No** | **Course code** | | **Name of the Course** | | **L** | **T** | | | **P/D** | | **C** | **Max. Marks** | |
|  |  | |  | |  |  | | |  | |  | **CIE** | **SEE** |
| 1 | 9B618 | | Dynamics of Machinery | | 2 | 1 | | | 0 | | 3 | 40 | 60 |
| 2 | 9B619 | | Heat Transfer | | 2 | 1 | | | 0 | | 3 | 40 | 60 |
| 3 | 9B620 | | CAD/CAM & Additive Manufacturing Processes(AMP) | | 3 | 0 | | | 0 | | 3 | 40 | 60 |
| 4 | 9B621 | | Machine Design | | 1 | 1 | | | 0 | | 2 | 40 | 60 |
| 5 |  | | Professional Elective-II | | 3 | 0 | | | 0 | | 3 | 40 | 60 |
| 6 |  | | Open Elective-I | | 3 | 0 | | | 0 | | 3 | 40 | 60 |
| 7 |  | | Artificial Intelligence (Grade Award) | | 3 | 0 | | | 0 | | 0 | Satisfactory/Not Satisfactory | |
| 8 | 9B671 | | Heat Transfer Lab | | 0 | 0 | | | 2 | | 1 | 40 | 60 |
| 9 | 9B672 | | KOM & DOM Lab | | 0 | 0 | | | 2 | | 1 | 40 | 60 |
| 10 | 9B673 | | CAD/CAM & AMP Lab | | 0 | 0 | | | 2 | | 1 | 40 | 60 |
| 11 | 9B674 | | Comprehensive Viva-voce | | - | 1 | | | - | | 1 | 100 | - |
|  |  | | Summer Industry Internship – II (Evaluation in IV-I) | | - | - | | | - | | - | - | - |
|  |  | | **Total** | | **17** | **4** | | | **6** | | **21** | **460** | **540** |



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|  | **A22-Course Structure for B. Tech.(Mech.) -IV Year – I Semester (7th Semester)** | | | | | | | | | |
| **Sl.No** | **Course code** | **Name of the Course** | | **L** | **T** | **P/D** | | **C** | **Max. Marks** | |
|  |  |  | |  |  |  | |  | **CIE** | **SEE** |
| 1 |  | Universal Human Values | | 3 | 0 | 0 | | 3 | 40 | 60 |
| 2 | 9B726 | Finite Element Methods | | 2 | 1 | 0 | | 3 | 40 | 60 |
| 3 | 9B727 | Metrology & Instrumentation | | 2 | 0 | 0 | | 2 | 40 | 60 |
| 4 |  | Professional Elective-III | | 3 | 0 | 0 | | 3 | 40 | 60 |
| 5 |  | Professional Elective-IV | | 3 | 0 | 0 | | 3 | 40 | 60 |
| 6 |  | Open Elective-II | | 3 | 0 | 0 | | 3 | 40 | 60 |
| 7 | 9B775 | Metrology& Instrumentation lab | | 0 | 0 | 3 | | 1.5 | 40 | 60 |
| 8 | 9B776 | Computer Aided Engineering Lab | | 0 | 0 | 3 | | 1.5 | 40 | 60 |
| 9 | 9B777 | Summer Industry Internship-II | | 0 | 0 | 2 | | 1 | 40 | 60 |
|  |  | **Total** | | **17** | **1** | **8** | | **21** | **360** | **540** |
|  | **A22-Course Structure for B. Tech.(Mech.)-IV Year – II Semester (8th Semester)** | | | | | | | | | |
| **Sl.No** | **Course code** | | **Name of the Course** | **L** | **T** | | **P/D** | **C** | **Max. Marks** | |
|  |  | |  |  |  | |  |  | **CIE** | **SEE** |
| 1 |  | | Professional Elective –V | 3 | 0 | | 0 | 3 | 40 | 60 |
| 2 |  | | Open Elective-III | 3 | 0 | | 0 | 3 | 40 | 60 |
| 3 | 9B878 | | Project | - | - | | 20 | 10 | 40 | 60 |
|  |  | | **Total** | **6** | **0** | | **20** | **16** | **120** | **180** |

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|  | **Professional Electives (PE)** | | | | | | | | |
| **Course  Code** | **PE– I** | **Course  Code** | **PE – II** | **Course  Code** | **PE – III** | **Course  Code** | **PE – IV** | **Course  Code** | **PE – V** |
| **(3-1)** | **(3-2)** | **(4-1)** | **(4-1)** | **(4-2)** |
| 9B514 | Industry 4.0 | 9B622 | Mechanical Vibrations | 9B728 | Industrial Robotics | 9B732 | Industrial Management | 9B836 | Composite Materials |
| 9B515 | Power Plant Engineering | 9B623 | Refrigeration & Air Conditioning | 9B729 | Non Conventional Energy Sources | 9B733 | Computational Fluid Dynamics | 9B837 | Jet Propulsion & Rocket Engineering |
| 9B516 | Operations Research | 9B624 | Total Quality Management | 9B730 | Production Planning and Control | 9B734 | Unconventional Machining Processes | 9B838 | Mechatronics |
| 9B517 | Automotive Chassis | 9B625 | Automotive Engines | 9B731 | Electric and Hybrid Vehicle | 9B735 | Vehicle Dynamics | 9B839 | Alternate Fuels |

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| **Open Elective Streams** |  | **Open Elective (OE)** | | | | |
| **Course  Code** | **OE– I** | **Course  Code** | **OE – II** | **Course  Code** | **OE – III** |
|  |  |  |  |
| Entrepreneurship Stream |  | Basics of Entrepreneurship |  | Advanced Entrepreneurship |  | Product and Services |
| Social Sciences Stream |  | Basics of Indian Economy |  | Basics of Polity |  | Indian History, Culture and Geography |
| Innovation and Design Thinking Stream |  | Design literacy and Design Thinking |  | Co-Creation and Product Design |  | Entrepreneurship & Business Design |
| Finance Stream |  | Banking Operations, Insurance and Risk Management |  | Entrepreneurship Project Management and Structured Finance |  | Financial Institutions, Markets and Services |
| ECE |  | Fundamental of Digital Circuits and Microprocessors |  | Introduction to VLSI Design |  | Internet of things( IOT) |
| CSE |  | Database systems Concepts |  | Operating Systems Concepts |  | Computer Networks |
| EEE |  | Control System Engineering |  | Special Machines |  | Fundamentals of Measurements and Instrumentation |

**Syllabus for B. Tech. III Year I semester**

**Mechanical Engineering**

**APPLIED THERMODYNAMICS-II**

**Code: 9B509**

**L T P/D C**

**2 1 --- 3**

**Pre-requisites:** TD and ATD-I

**Course Objectives:**

*The main objective of the course is to offer the students fundamental knowledge of Rankin cycles,*

*Working of different boilers, working principle of different types of Turbines & Rocket engines.*

**Course Outcomes**

*After completing the subject, students will be able to:*

**CO1: Analyze** the steam power plant layout and identify the Rankine cycle on p-v, T-S and h-s diagrams. **Evaluate**  the thermal efficiency of Rankine cycle

**CO2: Explain**  the working principles and basic design parameters of different types of boilers.

**CO3: Discuss** the function of steam nozzle, and criteria to decide nozzle shape, Wilson lineand **solve** velocity of nozzle at exit.

**CO4: Describe** the compounding of turbines and draw and **calculate** different parameters from velocity diagrams.

**CO5:Demonstrate** the working principles of different condensers and **evaluate** the performance of the gas turbine power plants.

**CO6: Estimate** and **examine** the working principle of jet propulsion and rocket engines.

**UNIT – I:Basic Concepts:** Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temp0erature of Heat addition, Methods to improve cycle performance – Regeneration & reheating

**UNIT – II:Boilers :** Classification – Working principles – with sketches including H.P.Boilers –Working principles, Boiler horse power, equivalent evaporation, Draught, classification – Height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney

**UNIT – III:Steam Nozzles :** Function of nozzle – applications - types, Flow through nozzles, thermodynamic analysis – assumptions -velocity of nozzle at exit-Ideal and actual expansion in nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, criteria to decide nozzle shape: Super saturated flow, its effects, degree of super saturation and degree of under cooling - Wilson line.

**UNIT –IV:Steam Turbines:** Classification – Impulse turbine; Mechanical details – Velocity diagram – effect of friction – power developed, axial thrust, blade or diagram efficiency – condition for maximum efficiency.

De-Laval Turbine - its features. Methods to reduce rotor speed-Velocity compounding and pressure compounding, Velocity and Pressure variation along the flow – combined velocity diagram for a velocity compounded impulse turbine.

**Reaction Turbine:** Mechanical details – principle of operation, thermodynamic analysis of a stage, degree of reaction –velocity diagram – Parson’s reaction turbine – condition for maximum efficiency.

**UNIT – V:Steam Condensers** : Requirements of steam condensing plant – Classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its affects, air pump- cooling water requirement.

**Gas Turbines :** Simple gas turbine plant – Ideal cycle, essential components – parameters of performance – actual cycle – regeneration, inter cooling and reheating –Closed and Semi-closed cycles – merits and demerits, Brief concepts about compressors, combustion chambers and turbines of Gas Turbine Plant.

**UNIT – VI:Jet Propulsion :** Principle of Operation –Classification of jet propulsive engines – Working Principles with schematic diagrams and representation on T-S diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo jet engines – Needs and Demands met by Turbo jet – Schematic Diagram, Thermodynamic Cycle, Performance Evaluation Thrust Augmentation – Methods.

**Rockets:** Application – Working Principle – Classification – Propellant Type – Thrust, Propulsive Efficiency – Specific Impulse – Solid and Liquid propellant Rocket Engines.

**TEXT BOOKS:**

1. Thermal Engineering / R.K. Rajput / Lakshmi Publications

2. Gas Turbines – V.Ganesan /TMH

3.Refrigeration And Air Conditioning by Arora and Domkundwar-Dhanpat Rai & Co

**REFERENCES:**

1. Thermodynamics and Heat Engines / R. Yadav / Central Book Depot

2. Gas Turbines / Cohen, Rogers and Saravana Muttoo / Addison Wesley – Longman

3. Thermal Engineering-R.S Khurmi/JS Gupta/S.Chand.

S**yllabus for B. Tech. III Year I semester**

**Mechanical Engineering**

**KINEMATICS OF MACHINERY**

**Code: 9B5110**

**L T P/D C**

2 1 0 3

Pre-Requisite subjects: Engineering Graphics, Engineering Mechanics.

**COURSE OBJECTIVES:** The main objective of this course is intended to cover the field of engineering theory, analysis, design, and practice that is generally described as mechanisms and kinematics of machines.

***Course Outcomes***

*After completing the subject, students will be able to:*

*1. Explain inversions of four bar and slider crank mechanisms and Evaluate veclocity and acceleration of four and six linked planer mechanism using Graphical and Instantaneous center method*

*2.Asses performances of Steering gear mechanisms and power transmitting elements (Gears, gear trains, Belt and Chain drives) analytically..*

*3. Analyse kinematics of CAMS graphically with both inline and offset roller and knife edge followers*

**UNIT – I**

**Mechanisms:** Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially, or successfully constrained and incompletely constrained. Number, type, and dimensional synthesis- definitions only.

**Machines:** Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism – inversion of mechanism – inversions of quadric cycle, chain – single and double slider crank chains.

**UNIT - II**

**Kinematics:** Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration diagrams – Graphical method – Application of relative velocity method four bar chain.

**Analysis of Mechanisms:** Analysis of slider crank chain for displacement, velocity, and acceleration of slider – Acceleration diagram for a given mechanism, Kleins construction, Coriolis acceleration, determination of Coriolis component of acceleration.

**Plane motion of body:** Instantaneous centre of rotation, centrod and axode – relative motion between two bodies – Three centres in line theorem – Graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links.

**UNIT – III**

**Steering Mechanisms:** Conditions for correct steering – Davis Steering gear, Ackerman’s steering gear – velocity ratio.

**Hooke’s Joint:** Single and double Hooke’s joint – Universal coupling – application – problems.

**UNIT –IV**

**Cams:** Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower motion - Uniform velocity – Simple harmonic motion and uniform acceleration. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases.

**Analysis of motion of followers:** Roller follower – circular cam with straight, concave, and convex flanks.

**UNIT – V**

**Toothed Gears**: Higher pairs, friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion, Form of teeth: cycloidal and involute profiles. Velocity of sliding – phenomena of interferences – Methods of interference.

Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact – Introduction to Helical, Bevel and worm gearing.

**Gear Trains:** Introduction – Train value – Types – Simple and reverted wheel train – Epicyclic gear Train. Methods of finding train value or velocity ratio – Epicyclic gear trains. Selection of gear box-Differential gear for an automobile.

**UNIT – VI**

**Belt Rope and Chain Drives:** Introduction, Belt and rope drives, selection of belt drive- types of belt drives, belts, materials used for belt and rope drives, velocity ratio of belt drives, slip of belt, creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt, Chains- length, angular speed ratio, classification of chains.

**TEXT BOOKS:**

1. Theory of Machines and Mechanisms-S.S.Rattan, Tata McGraw Hill Publishers

2. Theory of Machines R.S Khurmi & J.K Gupta

**REFERENCE BOOKS:**

1. Theory of Machines by Thomas Bevan/ CBS

2. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age

3. The theory of Machines /Shiegley/ Oxford.

**Syllabus for B. Tech. III Year I semester**

**Mechanical Engineering**

**METAL CUTTING & MACHINE TOOLS**

**Code: 9B511**

**L T P/D C**

**3 -- --- 3**

**Pre-requisites:** Manufacture Processes

**Course Objectives:**

To teach students the fundamental concepts of Machine tools involved and their advantages and limitations and various applications of these technologies in relevant fields such as mechanical, Bio-medical, Aerospace, electronics etc.

**Course Outcomes:**

After completing the subject, students will be able to:• Explain the basic metal cutting processes and aware of cutting forces using merchant circle method. [CO1]•Asses the tool wear and tool life and realise the influence of cutting fluid and cutting tool materials in machining. [CO2]• Explain the working principle of different machine tools and applications. [CO3]•esign the Jigs & Fixtures, 3-2-1 principle and know the working principle of some unconventional machining processes [CO4]

**UNIT – I**

Metal cutting theory – Elements of cutting process, cutting speeds, feed, depth of cut, Geometry of single point tool and angles, Orthogonal and Oblique machining, Mechanism of Chip formation-shear angle relation, types of chips, Velocity relationship, chip breakers-types, Mechanics of orthogonal cutting –Merchant’s Force diagram-derivations of forces, stress and strain in chip – Problems.

**UNIT – II**

Sources of heat in metal cutting, Failure of cutting tool and Tool crater and flank wear, Tool life-Taylor’s Equation- Problems, Factors effecting tool life, Cutting Fluids-Functions, qualities, types, Machinability, Machinability index, Cutting tool materials-properties and types.

**UNIT – III**

Lathe – Principle of working, types of Lathes, Parts of Lathe, specification of lathe, Lathe operations, Taper turning & thread turning methods - estimation of machining time in turning operation.

Shaping - Principal parts, Principles of working – Quick return mechanisms, operations performed, machining time calculations. Planning and slotting machines –Principle of working and comparison with respect to shaper.

Drilling – type of drilling machines, parts of radial drilling machines, various hole making operations –Elements & angles of twist drill – estimation of Machining time.

**UNIT – IV**

Milling machine – Principle of working, Milling methods–Up & Down Milling, Various Milling operations, Indexing heads, Indexing Methods: direct, plain and differential indexing. Problems.

Broaching -Types-Classification-Broach Elements-Advantages-Limitations.

**UNIT –V**

Grinding machine – cutting action – classification of grinding machines – cylindrical and surface grinding machine –Different types of abrasives and bonds, symbolic representation of bonds, grit, grade and structure, method of Specifying grinding wheel and selection of a grinding wheel, Loading and glazing of grinding wheels, Truing and Dressing the grinding wheels, Lapping, Honing and burnishing – principle and applications.

**UNIT - VI**

Jigs and fixtures- Differences, Need, Elements of Jigs & Fixtures, Main Principles of location and clamping: 3-2-1 location principle – Types of Locating devices. Introduction to unconventional machining processes - USM, EDM, ECM and LBM – advantages, applications.

**TEXT BOOKS:**

1. A course in Workshop Technology Vol II (Machine tools) – B. S. Raghu Vamshi – Dhanpat Rai & Co.

2. Production Technology by R.K. Jain and S.C. Gupta.

**REFERENCES:**

1. Manufacturing Science, Amithabha Ghosh and Mallik, Affiliated East West Press

Production Engineering / P.C. Sharma / S. Chand & Co.

**Syllabus for B. Tech. III Year I semester**

**Mechanical Engineering**

**DESIGN OF MACHINE ELEMENTS**

**Code: 9B512**

**L T P/D C**

**2 1 --- 3**

**Pre-Requisite:** MOS,KOM and DOM

**Course Objectives:**

1. learn the mechanical design process / philosophy, the need for and use of standards as part of the same, the selection of materials for mechanical design.
2. Learn to design mechanical components subjected to static and variable loading, apply related theories of failure to design based on strength and rigidity; and apply the concepts thereof to design of various fundamental mechanical components.

***Course Outcomes:***

*After completing the subject, students will be able to:*

*1. Design machine members subjected to steady loads and fatigue loads using static and dynamic theories of failure [CO1]*

*2. Analyze stresses in shafts, keys and couplings with design requirements.[CO2]*

*3. Analyse and Design the helical coiled and leaf springs under static and dynamic loads.[CO3]*

*4. Calculate stresses developed in Temporary (bolted) and permanent (riveted and welded) joints with the attention to design requirements.[CO4]*

**UNIT I: Introduction:**

Basic design process and requirements of machine design, use of standards in design, design synthesis; Engineering materials, stress-strain diagrams, mechanical properties of engineering materials; Materials selection techniques. Design for Tolerances of manufacturing.

**Design against static loading:**

Stresses due to axial loads, bending moment, torsional moment and eccentric axial loading, factor of safety, principal stresses, theories of elastic failure; Design of shafts under combined loading , Design of shafts carrying pulleys, gears etc.., Design for strength and rigidity, concept of stiffness in tension / compression, bending and torsion

**UNIT II: Design against Fluctuating Loads:**

Stress concentration & its factors, fluctuating stresses, fatigue failure, endurance limit, Soderberg, Goodman, Modified-Goodman and Gerber criterion, Fatigue design under combined stresses. Design for finite and infinite life. Shaft design against fluctuating and shock loads.

**UNIT III: Design of Keys, Couplings and Joints:**

Types of keys, Design of saddle, sunk, feather, Woodruff and Kennedy keys.

Design of couplings – Muff and Split Couplings, Flange, Flexible and Marine type of couplings.

**UNIT IV: Design of springs:**

Types of springs, terminology of helical spring, stress and deflection equations, spring materials, helical spring design against static and fluctuating loads, concentric springs, surge in springs.

Design of Leaf springs, Materials for Springs.

**UNIT V: Design of Threaded joints:**

Design of bolts and nuts, locking devices, bolt of uniform strength, design of gasket joints, design of power screws and screw jack Bolted joint design with static loads and fluctuating loads, eccentrically loaded bolted joints. Design of Nuts

**Design of Riveted joints:** Types riveted joints, failures of riveted joints, design of lap and butt riveted joints, Eccentric loading of riveted joints.

**UNIT VI: Welded joints:** Types of welded joints, strength of butt and fillet joints, axially loaded symmetrical and unsymmetrical welded joints, bending moment and tensional moment, welded joints subjected to eccentric and variable loading.

**TEXTBOOKS:**

1. **Design of Machine Elements** – Third Edition / V.B.Bhandari / Tata McGraw-Hill Pub.
2. **Mechanical Engineering Design** / J.E.Shigley, C.R.Mischke / Tata McGraw-Hill Pub.
3. Materials Selection in Mechanical Design / Michael F. Ashby
4. Mechanical Design Handbook/PSG

**REFERENCE BOOKS:**

**Fundamentals of Machine Elements** / Bernard Hamrock, Steven Schmid, Bo Jacobson / Tata McGraw Hill

1. A Text of Machine Design – R S Khurmi
2. Design of machine Elements -Kulakarni

**Syllabus for B. Tech. III Year I semester**

**Mechanical Engineering**

**COMPUTER AIDED MACHINE DRAWING**

**Code :9B513**

**L T P/D C**

1 0 4 3

**Course Objective:**

1. To familiarize with the standard conventions for different materials and machine parts in working drawings.

2. To make part drawings including sectional views for various machine elements.

3. To prepare assembly drawings given the details of part drawings.

***Course Outcomes:***

*After studying this course, the students will be able to:*

*1. Draw views of threads couplings, Riveted joints including their sectional views.*

*2. Acquire the techniques of assembly drawing and draw assemble drawings of I.C.engine parts ,Machine Tool Parts and valves.*

*3.Draw and Explain CAD 2D and 3D Drawings.*

**UNIT-I : Machine Drawing Conventions**

a) Sectional views: section planes and drawing of sections, Types of sectional views – Full sectional view, half sectional view, auxiliary sectional views, Parts not usually sectioned

b) Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.

**UNIT-II : Drawing of simple machine parts**

Selection of Views, additional views for the following machine partswith easy drawing proportions.

Popular forms of Screw threads like V, Metric, BSW, Buttress, Square, ACME, Worm nuts like square and hexagonal headed, Bolts like square and hexagonal headed, eye bolt, foundation bolts, stud bolts, set screws, washers Keys, cotters & joints and knuckle joint.

**UNIT-III : Drawing of machine elements**

Selection of Views, additional views for the following machine elements and parts with easy drawing proportions

Shaft coupling: Flange, Split-Muff, Flexible couplings, Claw, Oldham’s and Universal Coupling

Riveted joints for plates.

**Drawing of Machine Elements: Using Computer aided drafting in addition to manual drawing**

**UNIT-IV : Assembly Drawings of Engine parts**

Stuffing box, Cross head, Eccentric, Connecting rod - Drawings of assembled views for the part drawings using conventions and easy drawing proportions

**Assembly Drawings of Valves and Detailed drawings**

Steam stop valve, spring loaded safety valve, feed check valve and air cock - Drawings of assembled views for the part drawings using conventions and easy drawing proportions

**UNIT-V : Assembly Drawings of Machine parts**

Screws jack, Tailstock, Machine Vice, Plummer block, foot step bearing - Drawings of assembled views for the part drawings using conventions and easy drawing proportions

**UNIT-VI :Computer Aided 2D Drafting:**

1.Introduction to Auto CAD, Setting up drawing environment, Command and System variables, Coordinate system.

2. Creating graphic primitives like Point, Line, Planes, Circle, Arc, Annotation etc.

3. Creating and editing 2D object, Layers and object Properties. Creating dimensions, Blocks and External reference.

4. Creating a layout to plot, documents, file formats.

**NOTE:** First angle projection to be adopted. The student should be able to provide working drawings of actual parts.

**TEXT BOOKS:**

1. Machine Drawing – Dhawan, S.Chand Publications

2. Machine Drawing –K.L.Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers

3. Shan Tickoo, “Auto CAD 2011: A Problem Solving Approach”, Autodesk Press USA.

**REFERENCES:**

1. Machine Drawing – P.S.Gill.

2. 4. Machine Drawing – ND Bhat

**Syllabus for B. Tech. III Year I semester**

**Mechanical Engineering**

**INDUSTRY 4.0**

(Professional Elective Course**- I)**

**Code: 9b514**

**L T P/D C**

**3 -- --- 3**

Course Out comes : Student will able to

1. explain the evaluation of Industry 4.0 intérms of smart factory and cyber physical systems.

2. Identify applications related to digital twin and assocations related to digital twin and assistance system for production

3.Present case studios on Augmented Reality

**Unit-1**: Introduction to Industry 4.0 • Definition of Industry 4.0 What is it all about and why do we have to change industrial production Videos from Bosch, Siemens, ABB, Automotive Industry (VW, Audi, Mercedes) • Developments in USA, Europe, China and other countries • Comparison of Industry 4.0 Factory and today's Factory The 10 most important things that will change with Industry 4.0 • Difference between conventional automation and Industry 4.0.

**Unit 2:** Basic principles and technologies of a Smart Factory • Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services • Big Data • Cyber-Physical Systems • Value chains in manufacturing companies • Customization of products • Digital Twins • Cloud Computing / Cloud Manufacturing • Security issues within Industry 4.0 networks

**Unit 3:** Cyber-Physical Systems (CPS) and Cyber-Physical Production Systems (CPPS) • What are cyber-physical systems? (Definitions, demarcation to embedded systems, ubiquitous computing, etc.) • Core elements of Cyber-Physical Systems and Cyber-Physical Production Systems • Control theory and real-time requirements • Self-organization principles ("Self-X", autonomy, negotiations) • Communication in cyber-physical systems • Design Methods for Cyber-physical Systems (Modelling, Programming, Model-Integrated Development) • Applications for cyber-physical systems (examples of existing or future applications in the field of manufacturing, traffic, medical technology, etc.)

**Unit 4**: Digital Twins in Production • Example: Real time use of Digital Twin (Video) • Basic concepts of Digital Twins • Benefits, impact and challenges • Features and Implementation of Digital Twins • Types of Digital Twins • Digital Twin use cases • Applications for digital twins in production (examples of existing or future applications in the field of manufacturing)

**Unit 5:** Assistance systems for production • The connected worker within the Industry 4.0 scenario • Diversity-driven workplaces (barrier free workplaces, accessibility in production) • Human-and task-centered assistance systems (e.g. motion capture system for training employees, etc.) • Technical tools (“Ambient Assisted Working” (AAW)) • Mobile information technologies • Shop floor information systems • Production line support systems (pick by light, assembly display systems, assembly control by vision, …) • Manipulator systems and intelligent chairs • Human work support by using exoskeletons • Applications assistance systems in production (examples of existing or future applications in the field of manufacturing)

**Unit 6**: The six main use-cases for Augmented Reality in Manufacturing • AR-devices an Overview (different versions, Videos) • Use case 1: Integrating Design and Manufacturing • Use case 2: Training Shop floor Workers • Use case 3: Supporting complex Assembly Operations • Use case 4: Service and Maintenance • Use case 5: Supporting complex Sales solutions • Use case 6: Executive Oversight and Data Visualisation • Applications with Augmented Reality (examples of existing or future applications in the field of manufacturing

TEXT BOOK:Alasdair Gilchrist – Industry 4.0 The Industrial Internet of Things- Apress

**Syllabus for B. Tech. III Year I semester**

**Mechanical Engineering**

**POWER PLANT ENGINEERING**

(Professional Elective Course**- I)**

**Code: 9B515**

**L T P/D C**

**3 -- --- 3**

**Pre-requisites : Thermodynamics and Fluid Mechanics**

**Course Objectives:**

The goal of this course is to become prepared for professional engineering design of conventional and alternative power-generation plants. The learning objectives include

1. Analysis and preliminary design of the major systems of conventional fossil-fuel steam-cycle power plants.

2. A working knowledge of the basic design principles of nuclear, gas turbine, combined cycle, hydro, wind,

geothermal, solar, and alternate power plants.

3. Awareness of the economic, environmental, and regulatory issues related to power generation.

***Course Outcomes:***

After completion of the course, student will able to

*Co1: Explain the basics of sources of Energy and combustion processes*

*Co2: Evaluate the details of the Internal combustion engine Plants.*

*Co3: Demonstrate models of hydro Electric Power Plant*

*Co4: Asses the significance of Non Conventional Energy plants*

*Co5: Explain the working of nuclear power plant*

*Co6: Solve the economics and environmental issues of power plants in India.*

**UNIT – I:**

Introduction to the Sources of Energy – Resources and Development of Power in India.**Steam Power Plant :** Plant Layout, Working of different Circuits, Fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.

**Combustion Process:** Properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader

stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system,cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.

**UNIT – II:**

**Internal Combustion Engine Plant:**

DIESEL POWER PLANT: Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel

supply system, air starting equipment, lubrication and cooling system – super charging. **Gas Turbine Plant:**

Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison. **Direct Energy Conversion:** Solar energy, Fuel cells, Thermo electric and Thermo ionic, MHD generation.

**UNIT – III:**

**Hydro Electric Power Plant:** Water power – Hydrological cycle / flow measurement – drainage area

characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways.

**Hydro Projects And Plants:** Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants.

**UNIT – IV:**

**Power From Non-Conventional Sources:** Utilization of Solar- Collectors- Principle of Working, Wind Energy – types –HAWT, VAWT -Tidal Energy.

**UNIT – V:**

**NUCLEAR POWER STATION:** Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor

operation.**Types of Reactors:** Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast

Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

**UNIT – VI:**

**Power Plant Economics And Environmental Considerations**: Capital cost, investment of fixed charges,

operating costs, general arrangement of power distribution, Load curves, load duration curve. Definitions of

connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises.Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution

control.

**TEXT BOOKS:**

1. Power Plant Engineering by P.C.Sharma, S.K.Kataria Pub

2. A Course in Power Plant Engineering by Arora and S. Domkundar

**REFERENCE BOOKS:**

1. A Text Book of Power Plant Engineering by Rajput, Laxmi Publications

2. Power plant Engineering by Ramalingam, Scietech Publishers

3. Power Plant Engineering by P.K.Nag, II Edition, TMH.

4. An Introduction to Power Plant Technology bby G.D. Rai.

5. Power plant Engineering by Elanchezhian, I.K. International Pub

**Syllabus for B. Tech. III Year I semester**

**Mechanical Engineering**

**OPERATIONS RESEARCH**

(Professional Elective Course-1**)**

**Code: 9B516**

**L T P/D C**

**3 -- --- 3**

**Pre requisites:** None

**Course Objectives:**

Understand the mathematical importance of development of model in a particular optimization models.

**Course Outcome:**

*Up on the completion of the course , Student will able to*

*CO1: Model Job allocation, Transportation &Assignment problems and solve them with the approach of Linear program.*

*CO2: Model and Solve problems related to Sequencing, Replacement and Inventory.*

*CO3: Solve problems of theory of gaming of m x n games and shortest path dynamic programming problems.*

**UNIT – I:**

Development – Definition– Characteristics and Phases – Types of models – Operations Research models –

applications.

**ALLOCATION:** Linear Programming Problem - Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method; Duality Principle.

**UNIT – II:**

**TRANSPORTATION PROBLEM:** Formulation – Optimal solution, unbalanced transportation problem –

Degeneracy. **Assignment problem:** Formulation – Optimal solution - Variants of Assignment Problem; Traveling Salesman problem.

**UNIT – III:**

**SEQUENCING:** Introduction – Flow **–**Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through ‘m’ machines

**REPLACEMENT:** Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

**UNIT – IV:**

**THEORY OF GAMES:** Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games –m x 2 & 2 x n games - graphical method – m x n games - dominance principle.

**INVENTORY:** Introduction – Single item, Deterministic models – Types - Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand discrete variable or continuous variable – Single Period model with no setup cost.

**UNIT – V:**

**WAITING LINES:** Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.

**UNIT-VI:**

**DYNAMIC PROGRAMMING :**Introduction – Terminology- Bellman’s Principle of Optimality – Applications of dynamic programming- shortest path problem – linear programming problem.

**TEXT BOOKS:**

1. Operation Research by J.K.Sharma, MacMilan.

2. Operations Research by ACS Kumar, Yesdee

**REFERENCE BOOKS:**

1. Operations Research: Methods and Problems by Maurice Saseini, ArhurYaspan and Lawrence Friedman

2. Operations Research by A.M.Natarajan, P.Balasubramaniam, A. Tamilarasi, Pearson Education.

3. Operations Research by Wagner, PHI Publications.

4. Introduction to O.Rby Hillier &Libermann, TMH.

**Syllabus for B. Tech. III Year I semester**

**Mechanical Engineering**

**AUTOMOTIVE CHASSIS**

(Professional Elective Course-1**)**

**Code: 9B517**

**L T P/D C**

**3 -- --- 3**

**Pre-requisite :Nil**

**COURSE OBJECTIVES:**

* • To illustrate the vehicle lay-out and body types
* • To provide the working of transmission systems
* • To learn the basic functionality of final drive, steering and suspension systems
* • To present the construction and working of brake and wheel and tyre assembly

***COURSE OUTCOMES:***

*After completion of the course, the student should be able to*

***CO-1:*** *Draw the lay-out parts of Vehicles chassis for given load points.*

***CO-2:*** *Comprehend the working of Clutch and Gearing system of Vehicles.*

***CO-3:*** *Solve Automatic and Manual Transmission types of power transmission.*

***CO-4:*** *Explain driveline system, steering and suspension systems.*

***CO-5:*** *Demonstrate working of brake, wheel and tyre assembly.*

**UNIT – I:**

**Frame and Body:** Classification of automobiles, layout of chassis and sub systems and their role, types of chassis - light, medium and heavy duty vehicle chassis. Role and requirement of a chassis frame, types of frames, materials, loading points and types of bodies.

**UNIT – II:**

**Clutch and Gear Box:** Types of clutch - single plate clutch, coil spring type and diaphragm spring type, multiple plate clutch, centrifugal clutch and clutch trouble diagnosis. Need for gearbox, types of gear box - sliding mesh, constant mesh and synchromesh, overdrives, transfer case, gear shifting mechanisms and transmission trouble diagnosis.

**UNIT – III:**

**Automatic Transmission:** Need for fluid coupling and torque converters, epicyclical gearbox, automatic transmission – automatic manual transmission, continuously variable transmission and fully automatic transmission, control mechanisms and limitations.

**UNIT – IV:**

**Drive Line and Final Drive:** Propeller shaft drive, torque reaction and drive thrust, Hotchkiss drive, torque tube drive and universal joints. Front axle and its types, stub axle and its types, rear axle and its types. Need for differential, working, non-slip differentials, differential lock and drive line and final drive trouble diagnosis.

**UNIT – V:**

**Steering System:** Principle of steering, Ackerman’s and Davis steering mechanisms, steering layout, types of steering gearbox, types of front axle and stub axle, steering geometry. Purpose, working and types of power steering.

**Suspension System:** Types of suspension - rigid axle suspension and independent suspension, types of suspension spring - leaf spring, coil spring, torsion bar spring, air spring, rubber spring and hydro elastic spring. Role and types of shock absorber, construction and working. Steering and suspension trouble diagnosis.

**UNIT – VI:**

**Brake System:** Stopping distance, time and braking efficiency, effect of weight transfer, braking torque, classification of brakes, drum and disc brakes, construction and working of mechanical, hydraulic, pneumatic, power-assisted brakes and servo brakes. Drum brake and disc brake trouble diagnosis.

**Tyres and Wheels:** Types and construction of wheel, tyre requirements, bias ply and radial ply tyres, tubeless tyres, wheel balancing and tyre rotation.

**TEXTBOOKS:**

1. Advanced Vehicle Technology, by Heinz Heisler, 2nd Edition, Butterworth Heinemann Publishers, 2002

2. Automotive Mechanics, by Giri N K, Khanna Publications, 2008

**REFERENCES:**

1. The Motor Vehicle, by Garrett T K, Newton K. and Steeds W., 13th Edition Butterworth Heinemann Publishers, 2001

2. Automotive Mechanics, by William Crouse and Donald Anglin, 10th Edition, McGraw- Hill Publication, 2010

3. Automotive Mechanics, by Srinivasan S, 2nd Edition, McGraw-Hill Publishing Company Ltd., 2003

4. Automotive Chassis, by Heldt P M, Chilton & Co., 1996

**Syllabus for B. Tech. III Year I semester**

**Mechanical Engineering**

**Cyber Security**

**(Mandatory Course)**

**Code:**

**L T P/D C**

**3 0 0 0**

**Pre Réquisit : Nil**

**Course Objectives:**

**Students will able to**

1. Explain network security, network security threats, security services, cyber forensic and countermeasures.

2. Compare computer security and Internet security and defensive techniques against cyber attacks.

3. Identify cyber crime related to mobile and laptop and apply Cyberspace laws.

4. State ethical laws of computer for different countries, Offences under the Cyberspace and Internet in India.

***Course Outcomes:***

***At the end of this course the student will be able to***

1. *Explain cyber-attacks ,types of cybercrimes and cyber forensics.*
2. *Identify cyber security and various forms of cyber attacks and countermeasures.*
3. *Asses obscenity and pornography in cyber space and the violation of Right of privacy on Internet.*
4. *List Cyber laws and also demonstrate how to protect them self and the entire Internet community from attacks.*
5. *Elucidate the chapters of the IT Act 2008, power of Central and State Government to make rules under IT Act 2008.*

**UNIT-I: Introduction to cyber Security**

Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc.,

**UNIT-II: Cyber Forensics:**

Introduction to cyber forensic, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics.

**UNIT-III: Cybercrime: Mobile and Wireless Devices:**

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones,

**UNIT-IV: Cyber Security: Organizational Implications:**

Introduction cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations.

**Cybercrime and Cyber terrorism:** Introduction, intellectual property in the cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cyber criminals.

**UNIT-V: Privacy Issues:**

Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc.

**UNIT-VI: Cyberspace and the Law &Miscellaneous provisions of IT Act.**

Introduction to Cyber Security Regulations, International Law. The INDIAN Cyberspace, National Cyber Security Policy. Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threats.

Other offences under the Information Technology Act in India, The role of Electronic Evidence and miscellaneous provisions of the IT Act.2008.

**TEXT BOOKS:**

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley

1. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

**REFERENCE BOOKS:**

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

3. Debby Russell and Sr. G.T Gangemi, "Computer Security Basics (Paperback)”, 2ndEdition, O’ Reilly Media, 2006.

4. Wenbo Mao, “Modern Cryptography – Theory and Practice”, Pearson Education, New Delhi, 2006.

5. Cyberspace and Cybersecurity, George Kostopoulos, Auerbach Publications, 2012.

6. Cyber Forensics: A Field Manual for Collecting, Examining, and Preserving Evidence of Computer Crimes, Second Edition, Albert Marcella, Jr., Doug Menendez, Auerbach Publications, 2007.

7. Cyber Laws and IT Protection, Harish Chander, PHI, 2013

**Syllabus for B. Tech. III Year I semester**

**Mechanical Engineering**

**APPLIED THERMODYNAMICS LAB**

**Code:9B568**

**L T P/D C**

**-- -- 2 1**

**Pre-requisites: ATD-I and ATD-II Theory.**

**Course Objectives:** To integrate the concepts, laws and methodologies from the first course in thermodynamics into the analysis of cyclic process. to apply the thermodynamic concepts into various thermal application like I.C Engines, Steam turbines, compressors and Refrigeration and Air Conditioning systems.

***Course Objectives:*** *After completing the subject, students will be able to :*

1. *Conduct Performance test on two stroke and four stroke IC engine and air compressor and calculate performance parameters with definite conclusions with the help of heat balance sheet****(CO1)***
2. *Disassemble and assemble of I.C engine and Valve timing diagram will make the student understand the internal components and their functionality and study of boilers****(CO2)***
3. *Calculate performance parameters of Vapour compression Refrigeration system and Air conditioning system with the help of* ***(CO3)***
4. *Conduct morse test on four stroke petrol engine and evaluate energy balance to the engine****.(CO4)***

**LIST OF EXPERIMENTS**

1. Two stage reciprocating compressor: performance test
2. Valve timing diagram of four stroke single cylinder diesel engine
3. Disassembly and assembly of diesel engine
4. Performance test on diesel engine
5. Performance test on four stroke petrol engine
6. Heat balance test on diesel engine
7. Morse test on four cylinder four stroke petrol engine
8. Determination of COP of Vapour compression refrigerator
9. Determination of psychometric properties of Air conditioning equipment
10. Computer based single cylinder diesel engine eddy current dynamometer

**LIST OF EQUIPMENT**

1. Cut Section of Four Stroke Diesel Engine
2. Four Stroke Single Cylinder Diesel Engine Dis-Assembly and Assembly
3. Four Stroke Multi Cylinder Petrol Engine
4. Four Stroke Single Cylinder Diesel Engine
5. Four Stroke Single Cylinder Petrol Engine
6. Single Acting two Stage Reciprocating Air Compressor
7. Single cylinder Diesel Engine Test Rig
8. Refrigeration tutor, 1/3 HP Capacity
9. Air Conditioner Trainer - Duct type
10. Variable compression ratio Diesel Engine

**Syllabus for B. Tech. III Year I semester**

**Mechanical Engineering**

**MACHINE TOOLS LAB**

**Code: 9B569**

**L T P/D C**

**-- -- 2 1**

**Pre-requisites: Machine Tools Theory.**

**Course Objectives:**

This course gives students the opportunity to obtain skills in machine shop operations under the supervision of qualified machine shop personnel. They also understand the safety aspects of handling machines and work effectively with others and conduct themselves ethically and responsibly in a machine shop context

**Course Outcomes:**

*After completing the Laboratory, students will be able to:*

* ***CO-1:****Make simple products using lathe and covering various machining operations as per drawing****CO-2:*** *Produce jobs as per drawing using shaper, Planer and Slotter machines****CO-3:****Understand the principle and working of Drilling machine and conduct various machining  
  operations as per drawing****CO-4:****Work on Tool & Cutter Grinding, Milling machine and conduct machining operations*
* ***CO-5:****Perform surface grinding operation and conduct alignment test on lathe and drilling machines***List of Experiments**Introduction to General purpose machine tools - Lathe, Drilling machine, Milling machine, Shaper and Grinding machines

1. Study and usage of measuring and inspection tools used in Machine tool laboratory: – Verniercaliper, micrometers, height gauge, V-block, surface plate, Bore gauges, Pitch gauges, straight edges, dial gauge, plug and ring gauges, slip gauges, tool maker’s microscope.
2. Lathe Operations-I: Facing, Plain turning, Step turning, Taper turning and Chamfering
3. Lathe Operations-II: Thread cutting, Grooving and Knurling
4. Drilling Operations-I: Drilling, Boring, Reaming
5. Drilling Operations-II: Counter boring, Counter sinking and Tapping
6. Shaping Operations: Machining of V-Block
7. Milling Operations
8. Surface Grinding Operations
9. Tool and Cutter Grinder: Grinding of Tool angles of single point cutting tool
10. Machine tool alignment test on Lathe

**LIST OF EQUIPMENT**

1. Lathe machines
2. Surface Grinding Machine
3. Tool & Cutter Grinding Machine
4. Bench Grinding Machine
5. Shaping Machine
6. Slotting machine
7. Vertical Milling Machine
8. Radial Drilling machine
9. Spirit level
10. Mandrel
11. Height Gauge

**Syllabus for B. Tech. III Year II semester**

**Mechanical Engineering**

**DYNAMICS OF MACHINERY**

**Code: 9B618**

**L T P/D C**

2 **1 -- 3**

**Pre-requisite:** Kinematics of Machinery

**Course Objectives**

*The main objective of this course is intended to cover the field of engineering theory, analysis, design and practice that is generally described as dynamics of machinery.*

**Course Outcomes**

*After completing the subject, students will be able to*

*1. Derive the expressions of friction torque in brakes, clutches and dynamometers etc. [CO1]*

*2. Assess the effect of precession motion on the stability of moving vehicles and develop the approach to reduce speed fluctuation in flywheels and governers [CO2]*

*3. Compute balancing of primary and secondary forces in multi rotary systems and inline and V engines with graphical and analytical methods [CO3]*

*4. Analyse of single degree freedom vibrating systems for their steady state responses. [CO4]*

**UNIT – I: FRICTION, CLUTCHES, BRAKES & DYNOMOMETERS:**

**FRICTION**: Inclined plane, friction of screw and nuts, pivot and collar, uniform pressure, uniform wear, friction circle and friction axis : lubricated surfaces, boundary friction, film lubrication.

**CLUTCHES:** Friction clutches- Single Disc or plate clutch, Multiple Disc Clutch, Cone Clutch, Centrifugal Clutch.

**BRAKES AND DYNAMOMETERS:** Simple block brakes, internal expanding brake, band brake of vehicle. Dynamometers – absorption and transmission types. General description and methods of operations.

**UNIT – II :GYROSCOPIC AND PRECESSIONAL MOTION:**

Static and dynamic force analysis of planar mechanisms.

Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships.

**UNIT –III:TURNING MOMENT DIAGRAM AND FLY WHEELS:**

Dynamics of Reciprocating Parts,Turning moment – Inertia Torque connecting rod angular velocity and acceleration, crank effort and torque diagrams – Fluctuation of energy – Fly wheels and their design. Porter   
Governer

**UNIT – IV:BALANCING:**

**Balancing of rotating masses:** Single plane and multiple mass systems – Multi mass in different parallel planes.

**UNIT –V: Balancing of Reciprocating Masses:** Primary, Secondary, and higher balancing of reciprocating masses.Analytical and graphical methods. Unbalanced forces and couples – examination of “V” multi cylinder in line and radial engines for primary and secondary balancing, locomotive balancing – Hammer blow,Swaying couple, variation of tractive efforts. Field balancing.

**UNIT – VI: VIBRATION:** Introduction, Definitions, Types of vibrations, Natural frequency,Free longitudinal vibrations, Spring –rotor systems. Equation of motion , Energy methods, Free & forced damped vibrations, Vibration Isolation & Transmissibility, Transverse vibrations Whirling of shafts, critical speeds, Dunkerleys method .Torsional vibrations, two and three rotor systems. Multi rotor system – Amplitude ratios

**TEXT BOOKS:**

1. Theory of machines and mechanisms-vicker, Shigley

2. Theory of Machines / S.S Rattan/ McGraw Hill Publ.

**REFERENCES:**

1. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age

**Syllabus for B. Tech. III Year II semester**

**Mechanical Engineering**

**HEAT TRANSFER**

**Code: 9B619**

**L T P/D C**

**2 1 -- 3**

**Pre-requisites : FluidMechanics and Thermodynamics**

**COURSE OBJECTIVE:**

To provide students with a fundamental understanding of the principles, mechanisms, and practical applications of heat transfer in various engineering and scientific contexts.

***COURSE OUTCOMES****:*

*After completing the subject, students will be able:*

1. *Derive differential equations for heat transfer and exhibit a rudimentary comprehension of the concepts of conduction, convection, and radiation.*
2. *Acquire a command of the principles of heat conduction and utilize them to solve conduction-related heat transfer problems, encompassing both steady-state and transient scenarios with or without internal heat generation.*
3. *Solve problems involving forced and free convection in situations involving both internal and external flows.*
4. *Integrate the concepts of heat transfer in phase change processes in industrial equipment and appliances such as power plants, heat exchangers and cooling systems.*
5. *Calculate Thermal radiation heat transfer between the surfaces and Implement the principles of radiation to resolve problems in grey and black bodies.*

**UNIT – I**

**Introduction:** Modes and mechanisms of heat transfer – Basic laws of heat transfer –General discussion about applications of heat transfer.

**Conduction Heat Transfer:** Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates.

**UNIT – II**

Simplification and forms of the field equation – steady, unsteady and periodic heat transfer – Initial and boundary conditions.

**One Dimensional Steady State Conduction Heat Transfer:** Homogeneous slabs, hollow cylinders and spheres – overall heat transfer coefficient – electrical analogy – Critical radius of insulation

**One Dimensional Steady State Conduction Heat Transfer:** Variable Thermal conductivity – systems with heat sources or Heat generation. Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin.

.

**One Dimensional Transient Conduction Heat Transfer :**Systems with negligible internal resistance – Significance of Biot and Fourier Numbers - Chart solutions of transient conduction systems.

**UNIT – III**

**Convective Heat Transfer :** Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation – Buckingham Pi Theorem and method– Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations.

**Forced convection: External Flows:** Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

**UNIT – 1V**

**Internal Flows:** Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this –Use of empirical relations for Horizontal Pipe Flow.

**Free Convection:** Development of Hydrodynamic and thermal boundary layer along a vertical plate – Use of empirical relations for Vertical plates and pipes.

**UNIT V**

**Heat Transfer with Phase Change: Boiling:** – Pool boiling – Regimes Calculations on Nucleate boiling, Critical Heat flux and Film boiling.

**Condensation:** Film wise and drop wise condensation –Nusselt’s Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

**Heat Exchangers:**

Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

**UNIT VI**

**Radiation Heat Transfer:**

Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

**TEXT BOOKS:**

1. Fundamentals of Engg. Heat and Mass Transfer / R.C.SACHDEVA / New Age International

**REFERENCE BOOKS:**

1. Heat Transfer / HOLMAN/TMH
2. Fundamentals Of Engineering Heat And MassTransfer - R. C. Sachdeva/ New Age
3. Heat Transfer – P.K.Nag/ TMH
4. Heat and Mass Transfer – R.K. Rajput – S.Chand& Company Ltd.
5. Heat and Mass Transfer-Kondandaraman

**Syllabus for B. Tech. III Year II semester**

**Mechanical Engineering**

**CAD/CAM&ADDITIVE MANUFCTURING PROCESSES**

**Code: 9B620**

**L T P/D C**

**3 0 - 3**

**Pre-requisites: nil**

**Course Objectives:**

To provide an overview of how computers are being used in design, development, manufacturing planning and manufacturing. To understand the need for integration of CAD/CAM techniques in design and manufacturing.

**Course Outcomes**:

At the end of the course the student will be able to

**CO1**. Demonstrate the CAD/CAM Tools and discuss basics of computer graphics and algorithms for scan conversion, and transformation in CAD.

**CO2.** Describe and prepare computer compatible mathematical models to represent curves and surfaces in Computer Aided Design(CAD)

**CO3**.Develop manual part programs for CNC Machine to simulate and manufacture industrial components

**CO4:** Determine the group technology, computer aided process planning techniques and demonstrate the skill set required to optimize the automated production systems

**CO5.** Explain appropriate level of understanding on principles of additive manufacturing processes and apply suitable software tools for the process

**UNIT – I**

Computers in Industrial Manufacturing, Product cycle, scope of CAD/CAM, selection criteria of CAD workstations. **Computer Graphics:** Graphic terminals, graphics coordinate systems Line drawing algorithms, line clipping algorithm, transformation of geometry, 2D & 3D transformations, mathematics of projections, hidden surface removal, database structures for graphic modeling.

**UNIT – II**

**Geometric modeling:** Requirements of Geometric modeling, Wireframe modelling- entities, curve representation methods, surface modeling-entities, surface representation methods, solid Modelling-B-rep, CSG representation, modeling facilities desired. Design applications: Mass property calculations and tolerance analysis

**UNIT – III**

**Numerical control:** NC, NC modes, NC elements, NC machine tools, structure of CNC machine tools, features of Machining center, turning center, CNC Part Programming: fundamentals, manual part programming methods, Computer Aided Part Programming.

**UNIT – IV**

**Group Technology:** Part family, coding and classification, production flow analysis, advantages and limitations, Computer Aided Processes Planning, Retrieval type and Generative type. **Computer Aided Quality Control (CAQC):** Terminology in quality control, the computer in QC, contact and Non-contact inspection methods, computer aided testing, integration of CAQC with CAD/CAM.

**UNIT-V**

Additive Manufacturing Process(AMP) vs Subtractive Manufacturing and forming processes, Classification and Benefits of AMP, AM process chain, L**iquid-based, Solid based and Powder based Additive manufacturing processes: W**orking principle, Materials used, Applications, Advantages and Disadvantages of SLA, FDM, SLS and LOM processes.

**UNIT-VI**

Build time calculations forSLA, FDM**,** Problems, **AM Data Formats:** STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, Features of various AM software’s like Magics, Mimics, Solid View, View Expert.

**TEXT BOOK:**

1. CAD / CAM A Zimmers & P.Groover /PE/PHI

2. CAD / CAM Theory and Practice / Ibrahim Zeid / TMH

3.Chua C.K., Leong K.F. and LIM C.S, Rapid prototyping; Principles and Applications, World Scientific Publications, Third Edition, 2010.

**REFERENCES:**

1. Automation, Production systems & Computer integrated Manufacturing/ Groover/P.E

2. Principles of Computer Aided Design and Manufacturing / Farid Amirouche / Pearson

3. Computer Numerical Control Concepts and programming / Warren S Seames / Thomson

**Syllabus for B. Tech. III Year II semester**

**Mechanical Engineering**

**MACHINE DESIGN**

**Code:9B621**

**L T P/D C**

**1 1 -- 2**

**Course Objectives:**

1. Students will understand the concepts associated with design of bearings, engine parts, gears, and cylindrical pressure vessels.
2. Students will understand the significance and apply statistical methods to design simple machine *members.*

***Course Outcomes:***

*A student achieving a passing grade in this course will be able to:*

*1.Design Journal and antifriction bearings using Expressions and Bearing Catalogue.[CO1]*

*2.Design parts of internal combustion engine: Cylinder, piston, connecting rod and crank shaft[CO2]*

*3.Design spur, helical, bevel gears and worm gears [CO3]*

*4.Derive and solve design expressions thin and thick pressure vessels and Explain statistical design methods[CO4]*

**UNIT I: Design of Bearings:**

**Sliding Contact Bearings:** Classification of bearings, Design Hydrodynamic bearimgs.basic modes of lubrication, Petroff’s equation, McKee equation, bearing design, selection of parameters, Design of Hydrostatic bearings. Selection bearing materials and lubricating oil

**Rolling contact bearings:**

Types of rolling contact bearings, Design of ball and roller bearings. static load carrying capacity, dynamic load carrying capacity, equivalent bearing load, load-life relationship, load factors, bearing reliability ,selection of bearing from manufactories catalogues.

**UNIT II: Design of I.C. Engine parts:**

Introduction of I.C.Engine**,** Design of Cylinder, piston, Piston rings, Piston pin, connecting rod & its ends and crank shaft. Material selection.

**UNIT III: Design of Gears-I**

**Spur Gears:** Classification of gears, gear terminology, undercutting, gear tooth failures; Force analysis; Strength analysis: bending strength (Lewis equation), beam and wear strength of gear tooth, checking for dynamic (Buckingham equation) and wear considerations; design procedure for spur gears (estimation of module, centre distance, face width etc).

**Beval Gears:** Classification, Terminology, Design calculations, Force Analysis.

**UNIT IV: Design of gears-II**

**Helical Gears**: Introduction, terms of helical gears, formative no.of teath, proportion of helical gears, Design equations of helical gears. design procedure for helical gears (estimation of module, centre distance, face width etc).

**Worm Gears:** Terminology, Design of Worm and gear, Heat Dessipation calculations, Effeceincy of worm gear. Force analysis.

**UNIT V: Design of Cylinders and Pressure Vessels:**

Thin and thick cylinders under internal and external pressures; Design of cylinders: Lame’s equation, Clavarino’s and Birnie’s equations, Barlow’s equation. Compound cylinders; thin spherical vessels; Design of end closures of thick and thin cylinder.

**UNIT VI: Statistical Considerations in Design:**

Frequency distribution, frequency curves, measures of central tendency and dispersion, probability distribution, Normal curve, design and natural tolerances; Probabilistic aspects of variations in geometry of machine elements, material properties, external loading and initial / boundary conditions, probabilistic approach to design, reliability. Introduction to failure analysis and design of simple machine elements when uncertainities modeled with mean and standard deviations.

**TEXTBOOKS:**

1. **Design of Machine Elements** – Third Edition / V.B.Bhandari / Tata McGraw-Hill Pub.
2. **Mechanical Engineering Design** / J.E.Shigley, C.R.Mischke / Tata McGraw-Hill Pub.

**REFERENCE BOOKS:**

1. **Fundamentals of Machine Elements** / Bernard Hamrock, Steven Schmid, Bo Jacobson / Tata McGraw Hill
2. Probabilistic Mechanical Design / Edward B. Haugen
3. A Text Book of Machine Design -Kurmi

**Syllabus for B. Tech. III Year II semester**

**Mechanical Engineering**

**MECHANICAL VIBRATIONS**

(Professional Elective Course**-II)**

**Code:9B622**

**L T P/D C**

**3 0 -- 3**

**Pre-requisites:** Dynamics of Machines

**Course objectives:** Understand various levels of vibrations and remedies for each of them.

***Course Outcomes:***

*At the end of the course, the student will be able to,*

*1.Analyse the causes and effects of vibration in single degree freedom vibrations and solve problems of SDF Vibrations.*

*2. Develop schematic models for physical systems and formulate governing equations of motion for two degree freedom system and multi degree freedom systems.*

*3. Analyze continuous vibration systems with boundary conditions*

*4.Compute critical speeds of rotating and reciprocating systems.*

**UNIT- I:**

**Single degree of Freedom systems - I:** Undamped and damped free vibrations, viscous damping,coulomb

damping, forced vibrations, Response to excitation, rotating unbalance and support excitation, vibration isolation and transmissibility.

**UNIT- II:**

**Single degree of Freedom systems - II:** Response to Non Periodic Excitations: unit impulse, unit step and unit Ramp functions, response to arbitrary excitations, The Convolution Integral, shock spectrum,System response by the Laplace Transformation method.

**UNIT- III:**

**Two degree freedom systems:** Principal modes- undamped, damped free and forced vibrations, undamped

vibrationabsorbers.Vibration measuring instruments: Vibrometers**:**velocity meters & accelerometers.

**UNIT- IV:**

**Multi degree freedom systems:** Matrix formulation, stiffness and flexibility influence coefficients, Eigen value problem, normal modes and their properties, Free and forced vibration by Modal analysis, Method of matrix inversion, Torsional vibrations of multi- rotor systems and geared systems, Discrete- Time systems.

**UNIT-V:**

**Continuous system:** Free vibration of strings – longitudinal oscillations of bars- traverse vibrations of beams-

Torsional vibrations of shafts.

**UNIT-VI:**

**Critical speeds of shafts**: Critical speeds without and with damping, secondary critical speed.

**Numerical Methods:** Rayliegh'sstodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer's methods.

**TEXT BOOKS:**

1. Elements of Vibration Analysis by Meirovitch, TMH, 2001

2. Mechanical Vibrations and sound engineering by A.G.Ambekar, PHI

**REFERENCE BOOKS:**

1. Mechanical Vibrations by SS Rao, Pearson, 2009, Ed 4,

2. Mechanical Vibration by RaoV.Dukkipati& J Srinivas, PHI, 2010.

3. Mechanical Vibratins by V. Ram Murthy.

4. Vibration problems in Engineering by S.P. Timoshenko.

5. Mechanical Vibrations by Seto, Schaum'sOutilines, McGraw Hill

**Syllabus for B. Tech. III Year II semester**

**Mechanical Engineering**

**REFRIGERATION & AIR CONDITIONING**

(Professional Elective Course**-II)**

**Code: 9B729**

**L T P/D C**

**3 0 -- 3**

**Pre-requisite**: Thermodynamics

**Course Objective**: To apply the principles of Thermodynamics to analyse different types of refrigeration and air conditioning systems and to understand the functionality of the major components.

***Course Outcomes****:*

*At the end of the course, the student should be able to*

*CO1:Compute COP of Air Refrigeration system and vapour compression Refrigeration System and explain the components of Refrigeration system*

*CO2: Illustrate and derive design requirements of the vapour Absorption system*

*CO3: Calculate heat and cool load calculations of the methods of Air conditioning system*

**UNIT – I:**

**Introduction to Refrigeration:** - Necessity and applications – Unit of refrigeration and C.O.P. – Mechanical

Refrigeration – Types of Ideal cycle of refrigeration.

Air Refrigeration: Bell Coleman cycle and Brayton Cycle, Open and Dense air systems – Actual air refrigeration system – Refrigeration needs of Air crafts- Air systems – Actual Air refrigeration system – Refrigeration needs of Air crafts – Application of Air Refrigeration, Justification – Types of systems – Problems.

**UNIT – II:**

Vapour compression refrigeration – working principle and essential components of the plant – Simple Vapour

compression refrigeration cycle – COP – Representation of cycle on T-S and p-h charts – effect of sub cooling and super heating – cycle analysis – Actual cycle Influence of various parameters on system performance – Use of p-h charts – Problems.

**UNIT III:**

**System Components:** Compressors – General classification – comparison – Advantages and Disadvantages.

Condensers – classification – Working Principles

Evaporators – classification – Working Principles

Expansion devices – Types – Working Principles

Refrigerants – Desirable properties – common refrigerants used – Nomenclature – OzoneDepletion – Global

Warming – Azeotropes and Zeotropes

**UNIT IV:**

Vapor Absorption System – Calculation of max COP – description and working of NH3 – water system – Li – Brsystem. Principle of operation Three Fluid absorption system, salient features.

Steam Jet Refrigeration System – Working Principle and Basic Components

Principle and operation of (i) Thermoelectric refrigerator (ii) Vortex tube or Hilsch tube.

**UNIT – V:**

**Introduction to Air Conditioning:**

Psychometric Properties & Processes – Sensible and latent heat loads – Characterization – Need for Ventilation,Consideration of Infiltration – Load concepts of RSHF, ASHF, ESHF and ADP.

Concept of human comfort and effective temperature –Comfort Air conditioning – Industrial air conditioning and Requirements – Air conditioning Load Calculations.

**UNIT-VI:**

Air Conditioning systems - Classification of equipment, cooling, heating humidification and dehumidification,

filters, grills and registers, deodorants, fans and blowers.

Heat Pump – Heat sources – different heat pump circuits – Applications.

**TEXT BOOKS:**

1. A Course in Refrigeration and Air conditioning by SC Arora&Domkundwar, Dhanpatrai

2. Refrigeration and Air Conditioning by CP Arora, TMH.

3. Refrigeration and Air Conditioning by Manohar Prasad, New Age

**REFERENCE BOOKS:**

1. Principles of Refrigeration by Dossat, Pearson Education

2. Basic Refrigeration and Air-ConditioningbyAnanthanarayanan, TMH

**Syllabus for B. Tech. III Year I semester**

**Mechanical Engineering**

**TOTAL QUALITY MANAGEMENT**

(Professional Elective Course-II**)**

**Code: 9B730**

**L T P/D C**

**3 -- --- 3**

**Course Outcomes :**

Co1 : Explain elements of TQM with the help of control charts

Co2 : Establish Buyer and supplier relationships by using bench marking and cost & quality of products

Co3 : Interpret the relation between TQM techniques and ISO certification suggestions.

UNIT-I

Introduction: The concept of TQM, Quality and Business Performance, Attitude and Involvement of Top Management, Communication, Culture and Management Systems.

Management of Process Quality: Definition of Quality, Quality Control, Product Inspection Vs Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

UNIT-II

Customer Focus and Satisfaction: Process Vs Customer, Internal Customer Conflict, Quality Focus, Customer Satisfaction, Role of Marketing and Sales, Buyer – Supplier Relationships.

UNIT-III

Bench Marking: Evolution of Bench Marking, Meaning of Bench Marking, Benefits of Bench Marketing, the Bench Marking Procedure, Pitfalls of Bench Marketing.

UNIT-IV

Organizing for TQM: The Systems Approach, Organizing for Quality Implementation, Making the Transition from a Traditional to a TQM Organization, Quality Circles, Seven Tools of TQM: Stratification, Check Sheet, Scatter Diagram, Ishikawa Diagram, Pareto Diagram, Kepner and Tregoe Methodology.

UNIT-V

The Cost of Quality: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost Information, Accounting Systems and Quality Management.

UNIT-VI

ISO9000: Universal Standards of Quality: ISO Around the World, The ISO9000 ANSI/ASQC Q-90, Series Standards, Benefits of ISO9000 Certification the Third Party Audit, Documentation ISO9000 and Services, the Cost of Certification Implementing the System.

Text Book:

1. Total Quality Management-Poornima M.Chandrantimath-Pearson 4th addition

2.Total Quality Management-Sai Publisher

**Syllabus for B. Tech. III Year II semester**

**Mechanical Engineering**

**AUTOMOTIVE ENGINES**

(Professional Elective Course-II**)**

**Code:9B731**

**L T P/D C**

**3 0 -- 3**

**COURSE PRE-REQUISITES:** Physics and chemistry

**COURSE OBJECTIVES:**

• To present the constructional details and combustion in automotive engines

• To learn the principle and functions of an automotive engine sub-systems

• To know engine measurements and performance characteristics

• To provide the concepts and working of unconventional engines

**COURSE OUTCOMES:**

*After completion of the course, the student should be able to*

***CO-1:*** *Describe constructional details of Engine and an automotive fuel systems*

***CO-2:*** *Discuss charging sensors and actuators in Automotives.*

***CO-3:*** *Analyze engine measurements and performance characteristics for Engines with cooling and vibration*

***CO-4:***  *demonstrate working of unconventional Engines.*

**UNIT – I: Engine:** Classification, principle, construction and working of four stoke and two stroke SI and CI engines. Theoretical and actual indicator, valve and port timing diagrams, stages of combustion in SI and CI engines, abnormal combustion and combustion chambers.

**UNIT – II: Fuel System:** Air fuel ratio requirements, principle and working of carburetor, multi- point fuel injection and gasoline direct injection. Diesel fuel injection pump, types of nozzles and common rail direct injection.

**UNIT – III:Engine Sensors and Actuators:** Role of engine management system, sensors – engine speed, mass air flow, manifold absolute pressure, throttle position, knock, temperature, exhaust oxygen level and accelerometers, actuators - solenoids, relays, piezoelectric force generators and stepper motors and engine mapping.

**UNIT – IV: Cooling and Lubrication:** Necessity of cooling, air-cooling, water cooling - thermosyphon and pump cooling, radiator, pump, thermostat, antifreeze solution and radiator fan. Mist, splash and forced lubrication, oil filters and oil pumps.

**UNIT – V: Engine Performance and Supercharging:** Engine power, measurement of friction power, engine efficiencies, performance characteristics and heat balance.

Supercharging - mechanical supercharging, turbocharging, types of superchargers and methods of supercharging.

**UNIT – VI: Unconventional Engines:** Stiriling engine - Working Principle, two piston engine, control system, fuel requirement, emissions, merits and demerits. Wankel engine - Construction and working, performance, emissions, merits and demerits.Variable compression ratio engine - Necessity, theoretical analysis, different methods.HCCI engine – principle and Strategies for Mixture Preparation, and stratified charge engine – methods of charge stratification.

**TEXT BOOKS:**

1. “Internal Combustion Engine Fundamentals”, by John B Heywood, 2nd Edition, McGraw-Hill Education, 2018

2. “Internal Combustion Engines”, by Mathur ML and Sharma RP, DhanpatRai Publications, New Delhi, 2014

**REFERENCES:**

1. “Internal Combustion Engines”, by Ganesan V, 4th Edition, Tata McGraw Hill, New Delhi, 2017

2. Advanced Vehicle Technology, by Heinz Heisler, Butterworth Heinemann Publishers, 2002

3. Introduction to Internal Combustion Engines, by Richard Stone, SAE Publications,1999

4. Internal Combustion Engine, by Willard W Pulkrabek, Prentice Hall Publication, 1997

**Syllabus for B. Tech. III Year II semester**

**Mechanical Engineering**

**ARTIFICIAL INTELLIGENCE**

**(Mandatory Course)**

**Code:**

**L T P/D C**

**3 0 0 0**

**Pre-requisites:** Nil

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**Course objective:**

To train the students to understand the significance of AI, different types of AI agents, various AI search algorithms, fundamentals of knowledge representation, building of simple knowledge-based systems and to apply knowledge representation, reasoning.

***COUR******SE OUTCOMES:***

*At the end of this course the student will be able to*

1. *Explain role and applications of Artificial Intelligence and Environment of AI.*
2. *Apply state space representation and calculate time and space complexities of exhaustive search and heuristic search together.*
3. *Distinguish different knowledge representation techniques and comprehend the applications of Probabilistic Reasoning and Bayesian Networks.*
4. *Analyze search algorithms , learning techniques and decision trees.*
5. *Use techniques to represent domain knowledge of the expert systems and subsets of AI.*

## UNIT - I

**Introduction to AI:** History and Future, Needs and Goals, Applications, Advantages and Disadvantages of AI, Types of AI, Intelligent Agents, Structure of an Agents, Types of Agents, Environment and its types, Turning Test, Introduction to syllogism.

**UNIT –II**

**Basic Search Strategies**: Terminologies and Properties of search algorithm, Problem Solving Agent and Problem Spaces, Types of Search Algorithms, Uninformed Search Algorithm (Breadth-First Search, Depth-First Search, Depth-first with Iterative Deepening, Depth limited search algorithm), Informed Search Algorithms (Heuristic Search : Generic Best-First, A\*, Hill Climbing).

## UNIT - III

**Advanced Search Strategies**: Constraint Satisfaction (Backtracking, Local Search), Adversarial Search, Zero Sum games, Constructing Search Trees, Stochastic Search, Minimax Search, and Alpha-Beta Pruning

## UNIT – IV

**Knowledge Representation and Reasoning**: Propositional Logic, First-Order Logic, Forward Chaining and Backward Chaining, Basic probability, Introduction to Probabilistic Reasoning, Acting under Uncertainty, Bayes Theorem and Rule, Bayesian Networks, Non- monotonic Reasoning, Knowledge Representation schemes and Issues

## UNIT - V

**Learning:** What Is Learning? Rote Learning, Learning by Taking Advice, Learning in Problem Solving, Learning from Examples, Winston’s Learning Program, Decision Trees. Machine Learning (Introduction to Supervised, Unsupervised and Reinforced learning)

## UNIT – VI

**Subsets of Artificial Intelligence:** Expert System (Introduction, Need, Capacities, Characteristics of Expert System, Expert System and its Components), Robotics, ANN, Genetic Algorithms (Introduction Only).

## TEXT BOOK:

* + 1. Russell, S. and Norvig, P, Artificial Intelligence: A Modern Approach, Third Edition, Prentice- Hall, 2010.

## REFERENCE BOOKS:

1. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivasankar B. Nair, The McGraw Hill publications, Third Edition, 2009.
2. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education, 6th ed., 2009.

**Syllabus for B. Tech. III Year II semester**

**Mechanical Engineering**

**HEAT TRANSFER LAB**

**Code: 9B671**

**L T P/D C**

**--- --- 2 1**

**Pre-requisites : Heat Transfer Theory.**

**Course Objectives :** Through this course, students will study about the various heat transfer processes, so as to train the students practically to utilize this knowledge in heat transfer related industries

***Course Outcomes:***

*After completing the subject, students will be able to*

*1. Compute the thermal conductivity of a given material rod and composite wall* ***(CO1)***

*2. Calculate thermal conductivity of lagged pipe and insulating powder under given conditions.****(CO2)***

*3. Determine the forced ad free convection heat transfer coefficients under given conditions .****(CO3)***

*4. Calculate LMTD for parallel flow and counter flow heat exchangers and overall heat transfer coefficient and pin fin apparatus.* ***(CO4)***

*5. conduct experiment on emissivity of a given surface and calculate Stefan-Boltzmann’s constant*

*experimentally.****(CO5)***

*6. Draw the boiling curve by showing different phases of boiling with the help of heat pipe* ***(CO6)***

**List of Experiments**

1. Composite Slab Apparatus – Overall heat transfer co-efficient.

2. Heat transfer through lagged pipe.

3. Thermal Conductivity of given metal rod.

4. Heat transfer in pin-fin

5. Experiment on Transient Heat Conduction

6. Heat transfer in forced convection apparatus.

7. Heat transfer in natural convection

8. Parallel and counter flow heat exchanger.

9. Emissivity apparatus.

10. Stefan Boltzman Apparatus.

11. Heat transfer in drop and film wise condensation.

**LIST OF EQUIPMENT**

1. Emmisivity Measurement Apparatus
2. Heat Transfer Through Lagged Pipe
3. Heat Transfer in Natural Convection
4. Heat Transfer in forced convection
5. Heat Transfer Composite wall
6. Parallel and counter flow Heat exchanger
7. Stefan Boltzman Apparatus
8. Thermal Conductivity of Metal Rod
9. Condensation in Drop wise Film wise forms
10. Heat Transfer from Pin Fin Apparatus
11. Transient Heat Conduction Apparatus

**Syllabus for B. Tech. III Year II semester**

**Mechanical Engineering**

**Kinematics & Dynamics of Machines Lab**

**Code: 9B672**

**L T P/D C**

**--- --- 2 1**

**Pre-requisites: Kinematics & Dynamics of Machines Theory.**

**Course Objective:**

To expose practical knowledge in kinematics and dynamics of planar mechanism and vibrations.

***Course Outcomes: -***

*After completing the Laboratory, students will be able to:*

1. *Understand the concept of vibrations, able to calculate the acceleration due to gravity and stiffness of the spring.*
2. *Estimate of radius of gyration*
3. *Draw the displacement diagram of cam and follower and obtain the characteristics of governor*
4. *Perform experiments on the torsional vibrations*
5. *Perform experiment on the gyroscopic effects and balancing of rotating masses*
6. *Analyse the pressure distribution in a journal bearing and compute critical speeds of shafts.*

**List of Experiments**

1. Evaluate the acceleration due to gravity with the help of simple pendulum
2. Calculate the radius of gyration of the given bar treating that as a compound pendulum
3. Draw the displacement diagram for the Cam and Follower
4. Find the modulus of rigidity for the given shaft
5. Verity the gyroscopic couple using motorized gyroscope
6. Study the pressure distribution of a Journal Bearing
7. Identify the stiffness of the given spring
8. Obtain the radius of gyration of a given bar using the Bifilar Suspension
9. Create the characteristic curves for the Hartnell Governor
10. Measure the modulus of rigidity of the given shaft
11. Examine the different fundamental frequencies of the given shaft
12. Estimate the required balancing mass using a rotating balancing

**List of Equipment**

1. Vibration Lab for experiments and vibrations, in modular form.
2. Universal governor apparatus.
3. Cam analyzer apparatus
4. Static and dynamic balancing apparatus
5. Whirling of shaft apparatus with stroboscope
6. Motorized gyroscope
7. Journal bearing
8. Digital stroboscope

**Syllabus for B. Tech. III Year II semester**

**Mechanical Engineering**

**CAD/CAM & AMP LAB**

**Code: 9B673**

**L T P/D C**

**-- -- 2 1**

**Pre-requisites : CAD/CAM Theory.**

**Course Objectives:**

Upon completion of this course the students will be able to

• Execute steps required for modelling 3D objects by using protrusion, cut, sweep, extrude commands

• Convert 3D solid models into 2D drawing-different views, sections

• Use isometric views and dimensioning of part models

• Machine simple components on CNC machines • Use CAM software to generate NC code

**Course Outcomes**

After completing the subject, students will be able to:

1. Draw computer Aided 2D drawings to solve design and manufacturing problems using CAD CAM principles.

2. Develop geometric modelling 3D components

3. Develop assemblies different machine elements and import and export CAD models one software to anther software

4. Write CNC part programming for turning and milling operations.

5. Fabricate components on CNC lathe, CNC mill and 3D FDM printer

6.Simulate the articulated robot and Fabricate components on 3D printing machine

**List of Experiments:**

1. Generation of various 2D Drawings (Minimum of five exercises

2. Three Dimensional Modelling of simple components (Minimum of five exercises)

3.3D Modelling and Assembly of Flange Coupling

4. Developing Assembly from part models of the Plummer block components.

5. Developing Assembly from part models of the Bench vice assembly components.

6. Developing Assembly of Press tool assembly.

7. Simulation of Tool path for CNC Lathe Operations.

8. Simulation of Tool path for CNC Mill Operations.

9. Machining of Simple Components on CNC Lathe.

10. Machining of Simple Components on CNC Mill.

11. Demo of Articulated Robot.

12. Manufacture of PARTS USING 3D-Printing FDM machine.

**LIST OF EQUIPMENT**

CNC Lathe

CNC Mill

6 Axis Robot

3d Printer

PRO-E / Creo University plus (Perpetual)

**Syllabus for B. Tech. IV Year I semester**

**Mechanical Engineering**

**UNIVERSAL HUMAN VALUES**

**Code:**

**L T P/D C**

3 0 0 3

**Human Values Courses:** This course also discusses their role in their family. It, very briefly, touches issues related to their role in the society and the nature, which needs to be discussed at length in one more semester for which the foundation course named as “H-102 Universal Human Values 2: Understanding Harmony”is designed which may be covered in their III or IV semester. During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

**Outcomes:** The outcomes of the course is four fold: student will able to

1. Develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.

2. Understand the harmony in the human being, family, society and nature/existence

3. Strengthen of self-reflection.

4. Develop of commitment and courage to action the human values.

**COURSE TOPICS**: The course has 28 lectures and 14 practice sessions in 5 modules:

**Module 1: Course Introduction** - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I

2. Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration

3. Continuous Happiness and Prosperity- A look at basic Human Aspirations

4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority

5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario

6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

**Module 2: Understanding Harmony in the Human Being** - Harmony in Myself!

7. Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’

8. Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility

9. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)

10. Understanding the characteristics and activities of ‘I’ and harmony in ‘I’

11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail

12. Programs to ensureSanyam and Health. Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one’s own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

**Module 3: Understanding Harmony in the Family and Society**- Harmony in Human-Human Relationship

13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship

14. Understanding the meaning of Trust; Difference between intention and competence

15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship

16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals

17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students’ lives.

**Module 4: Understanding Harmony in the Nature and Existence** - Whole existence as Coexistence

18. Understanding the harmony in the Nature

19. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature

20. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space

21. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology etc.

**Module 5: Implications of the above Holistic Understanding**

22. Natural acceptance of human values

23. Definitiveness of Ethical Human Conduct

24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

**Module 6:Harmony on Professional Ethics**

25. Competence in professional ethics:

a. Ability to utilize the professional competence for augmenting universal human order

b. Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,

c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

26. Case studies of typical holistic technologies, management models and production systems

27. Strategy for transition from the present state to Universal Human Order:

a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers

b. At the level of society: as mutually enriching institutions and organizations

28. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. to discuss the conduct as an engineer or scientist etc.

**3. READINGS:**

**3.1 Text Book**

1.Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010 3.

**2 Reference Books**

1.Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

2.Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004. 3.The Story of Stuff (Book).

4.The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

5.Small is Beautiful - E. F Schumacher.

6.Slow is Beautiful - Cecile Andrews

7.Economy of Permanence - J C Kumarappa

8.Bharat Mein Angreji Raj - PanditSunderlal

9.Rediscovering India - by Dharampal

10.Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

11.India Wins Freedom - Maulana Abdul Kalam Azad

12.Vivekananda - Romain Rolland (English)

13.Gandhi - Romain Rolland (English)

**Syllabus for B. Tech. IV Year I semester**

**Mechanical Engineering**

**FINITE ELEMNT METHODS**

**Code: 9B726**

**L T P/D C**

**2 1 -- 3**

**Pre-requisites**: Mechanics of Solids, Heat Transfer and Dynamics.

**Course Objectives:** The course is intended to

Gain a fundamental understanding of the finite element method for solving 1-D structural problem.

Formulate the finite element equations for truss and beam elements.

Study two-dimensional problems such as plain stress and plain strain elasticity problems.

Learn finite element analysis of 1-D and 2-D heat conduction and torsion problem Analysis the structures

by considering the mechanical vibrations.

***Course Outcomes****:*

*At the end of the course, the student will be able to,*

*1. Explain finite element method to solve problems in solid mechanics.*

*2.Formulate and solve problems in one dimensional structures such as axial bar, trusses, Beams with FEM*

*3. Formulate FE characteristic equations for two dimensional elements and analyze plain stress and plain strain,*

*4.Formulate and apply FE characteristic equations for steady state heat transfer Problems*

*5.Calcualte eigen values and eigen vector in Structural Dynamics Problems.*

**UNIT – I:**

Introduction to Finite Element Methods for solving field problems, Methods of Engineering Analysis, Functional Approximation Methods: Rayleigh- Ritz Method, Weighted Residual Methods, Applications of FEM, Advantages and Disadvantages of FEM, Stress and Equilibrium, Strain – Displacement relations, Stress – strain relations for 2D and 3D Problems. Basic Steps of FEM, Characteristics of Finite Element, Principle of Minimum Potential Energy, Convergence Requirements.

**UNIT – II:**

**One Dimensional Problems**: Formulation of Stiffness Matrix for a Bar Element by the Principle of Minimum

Potential Energy, Properties of Stiffness Matrix, Characteristics of Shape Functions, Quadratic. Problems on uniform and stepped bars for different loading conditions.

**Analysis of Trusses:** Derivation of Stiffness Matrix for Trusses, Stress and strain Calculations, Calculation of

reaction forces and displacements.

**UNIT – III:**

**Analysis of Beams:** Derivation of Stiffness matrix for two noded, two degrees of freedom per node beam element,Load Vector, Deflection, Stresses, Shear force and Bending moment, Problems on uniform and stepped beams for different types of loads applied on beams.

**UNIT – IV:**

**Finite element – formulation of 2D Problems:** Derivation of Element stiffness matrix for two dimensional CST Element, Derivation of shape functions for CST Element, Elasticity Equations, constitutive matrix formulation, Formulation of Gradient matrix. Two dimensional Isoperimetric Elements and Numerical integration.

**UNIT – V:**

**Steady state heat transfer analysis**: Galerkin’s approach, Steady state on-dimensional heat conduction problems, steady state heat transfer in thin fins, Two dimensional steady state heat conduction with triangular element.

**UNIT – VI:**

**Dynamic Analysis**: Formulation of mass matrices for uniform bar and beam Elements using lumped and consistent mass methods, Evaluation of Eigen values and Eigen vectors for a stepped bar and beam Problems.

**TEXT BOOKS**:

1. Introduction to Finite Elements in Engineering by Chandrupatla, Ashok and Belegundu, Prentice, Hall, Pearson

2. The Finite Element Methods in Engineering by SS Rao, Pergamon.

**REFERENCE BOOKS:**

1. Finite Element Methods: Basic Concepts and applicationsbyAlavala, PHI

2. Finite Element Method by Zincowitz, Mc Graw Hill

3. Introduction to Fininte element analysis by S.Md.Jalaludeen, Anuradha Publications, print-2012

4. Finite Element Analysis by P.Seshu, PHI

5. Finite Element Analysis by Hutton, TMH

6. Finite Element Analysis by Bathe, PHI

7. Finite Element Method by Krishna Murthy, TMH

**Syllabus for B. Tech. IV Year I semester**

**Mechanical Engineering**

**METROLOGY AND INSTRUMENTATION**

**Code: 9B727**

**L T P/D C**

**2 -- -- 2**

**Course Objectives:**

**The objectives of the course are to** provide required knowledge for mechanical measurements

The course exposes the students to the principles of measurement, gauges

***Course Outcomes:***

*After completing the subject, students will be able to :*

*CO1: Specify the fit and design tolerances for product quality and limit gauges.*

*CO2: Measure parameters on screw threads and gears, the features of basic measurement system static and*

*dynamic characteristics of instruments including errors.*

*CO3: Analyze the transducers used to measure pressure and temperature and*

*Explain the principle of different industrial devices used to measure the displacement, force and torque.*

**UNIT – I**

**Systems of limits and fits:** Introduction, normal size, tolerance limits, deviations, allowance, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly, Indian standard system-simple problems on calculation of tolerance,allowance,fits etc.

**UNIT – II**

**Limit Gauges:** Taylor’s principle – Design of go and No go gauges, plug, ring, snap, gap gauges, Problems on design of gauges.

**Screw Thread Measurement:** Elements of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch. Angle measurement-Sine bar, slip gauges, Bevel protractor

**UNIT- III**

**Gear Measurement:** Gear measuring instruments, Gear tooth profile measurement. Measurement of diameter, pitch, pressure angle and tooth thickness

**Surface Roughness Measurement:** Differences between surface roughness and surface waviness-Numerical assessment of surface finish – CLA, R.M.S Values, Rz value, Methods of measurement of surface finish-profilograph, Talysurf, Problems on calculating surface roughness values.

**UNIT – IV**

**Introduction and Basic principles of Measurement** – Measurement systems, Generalized configuration and functional descriptions of measuring instruments – examples. Dynamic performance characteristics, Sources of error, Classification and elimination of error.

**UNIT – V**

**Measurement of Pressure:** Units – classification – different principles used. Manometers, Bourdon pressure gauges, Bellows – Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge.

**Measurement of Temperature:** Classification – Ranges – Various Principles of measurement – Expansion, Electrical Resistance – Thermistor – Thermocouple – Pyrometers – Temperature Indicators.

**UNIT – VI**

**Measurement of Displacement:** Theory and construction of various transducers to measure displacement – Piezo electric, Inductive,LVDT,capacitance, resistance, ionization and Photo electric transducers.

**Measurement of Force And Torque -** Elastic force meters, load cells, Torsion meters, Strain gauge Rosettes.

**TEXT BOOKS:**

1. Engineering Metrology / I C Gupta./DanpathRai

2. Engineering Metrology / R.K. Jain / Khanna Publishers

3. Measurement Systems: Applications and Design by D.S Kumar.

4. Mechanical Measurements / BeckWith, Marangoni,Linehard, PHI / PE

**REFERENCES:**

1. Production Engineering/P.C.Sharma

2. Measurement systems: Application and Design, Doeblin Earnest. O. Adaptation by      Manik and      Dhanesh/ TMH

**Syllabus for B. Tech. IV Year I semester**

**Mechanical Engineering**

**INDUSTRIAL ROBOTICS**

**(Professional Elective-III)**

**Code:9B728**

**L T P/D C**

**3 - - 3**

**Prerequisites:** KOM & DOM

**Course Objectives:**

- to Understand the typical applications of robots in material transfer, machine loading/unloading; processing operations; assembly and inspection.

- to model the motions of Robotics with the concepts of kinematics and dynamics of robots.

- to understand the role of the sensors and Programming in implementing Robots in various applications.

***Course Outcomes:***

***After completion of the course , students will able to***

*1. demonstrate the robotic systems along with their classification and application areas.*

*2. model solve demonstrate the Robotic Kinematic Models and the Robotic dynamic models*

*3. plan joint trajectories in the presence/absence of obstacles and implement the control system concepts in robotics through linear and nonlinear control schemes.*

*4. explain sensory and vision systems used in robotics.*

**UNIT – I**

**Introduction and Applications to Robotics:** An over view and applications of Robotics, classification by coordinate system. Different types of robotic manipulators, Robotic actuators: pneumatic, hydraulic and electric.

**UNIT – II**

**Transformation and Manipulator Kinematics:**coordinateframesSpecifications of matrices, Homogeneous transformations as applicable to rotation and translation, D-H notation, Forward and inverse kinematics – problems.

**UNIT – III**

**Differential Motion , Statics and Dynamics of manipulators:** Differential transformations, Jacobians; Force and moment balance, Velocity analysis, Lagrange – Euler and Newton formulations– Euler formations for dynamics of 2D manipulators – Problems.

**UNIT - IV**

**Trajectory Planning**: Path planning, Skew motion, joint integrated motion – straight line motion.Problems

**UNIT - V**

**Control of Manipulators:** Introduction to control systems: open and closed loop control, transfer functions, characteristics of linear and nonlinear systems and their control schemes; model of a manipulator joint, actuator; control schemes applied in robotics: PID

**UNIT - VI**

**Robotics Sensors, Vision& Programming:** Classification of sensors, sensors in robotics; introduction to machine vision, image representation and processing. Introduction to Robotic Programming

**TEXT BOOKS:**

1. Robotics and Control / Mittal R K &Nagrath I J / TMH.

**REFERENCES:**

1. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons
2. Robotic Engineering / Richard D. Klafter, Prentice Hall
3. Robotics / Fu K S/ McGraw Hill.
4. Industrial Robotics MikelP.Groover Tata McGraw-Hill
5. A Text book of INDUSTRIAL ROBOTICS /Ganesh S.Hegde/Laxmi Publications

**Syllabus for B. Tech. IV Year I semester**

**Mechanical Engineering**

**NON CONVENTIONAL ENERGY SOURCES**

(Professional Elective Course **-III)**

**Code: 9B729**

**L T P/D C**

3 **0 0 3**

**Prerequisites:** None

**COURSE OBJECTIVES:**

To explain the concepts of Non-renewable and renewable energy systems

To outline utilization of renewable energy sources for both domestic and industrial applications

To analyse the environmental and cost economics of renewable energy sources in comparison with fossil fuels.

*COURSE OUTCOMES:*

*After completion of the course , students will able to*

*1. Assess renewable energy sources in respect of Indian energy scenario*

*2. Identify components of solar energy conversion systems*

*3. design wind energy systems with the help of power in the wind*

*4. implement system to convert biomass into Biogas plants*

*5. Demonstrate the details of ocean Energy in terms of tidal and wave energy*

*6. compare Hydro power plants and Geothermal plants.*

**UNIT-I:**

**Global and National Energy Scenario:** Over view of conventional & renewable energy sources, need &

development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, CO2reduction potential of renewable energy- concept of Hybrid systems.

**UNIT-II:**

**Solar Energy:** Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal,applications of solar energy systems.

**UNIT-III:**

**Wind Energy:** Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection, Types of wind turbines, Wind farms, wind Generation and Control. Nature of the wind, power in the wind, factors

influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics,applications of wind turbines, offshore wind energy – Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices. Wind mill component design, economics and demand side management,energy wheeling, and energy banking concepts. Safety and environmental aspects, wind energy potential and installation in India.

**UNIT-IV:**

**Biogas:** Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy

system, design and constructional features. Biomass resources and their classification, Biomass conversion

processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction,

biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass,bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

**UNIT-V:**

**Ocean Energy:** Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.

**UNIT-VI:**

a. **Small hydro Power Plant:** Importance of small hydro power plants and their Elements, types of turbines for small hydro, estimation of primary and secondary power.

b. **Geothermal Energy**: Geothermal power plants, various types, hot springs and steam ejection.

**Text Books:**

1. Power plant technology by J Wakhil

2. Non-Conventional Energy Sources by G.D Rai

**Reference Books:**

1. Solar Energy - Principles of thermal collection and storage by S. P. Sukhatme

2. Solar Engineering of Thermal Processes by J. A. Duffie and W. A. Beckman

3. Biomass Regenerable Energy by D. D. Hall and R. P. Grover.

4. Renewable Energy Sources by Twidell, J.W. and Weir, A., EFN Spon Ltd., 1986.

5. Renewable Energy Engineering and Technology by Kishore VVN,, Teri Press, New Delhi, 2012

6. Sustainable Energy Systems Engineering by Peter Gevorkian, McGraw Hill,2007

7. Principles of Solar Engineering by Kreith, F and Kreider, J. F., McGraw-Hill, 1978.

8. Renewable Energy, Power for a Sustainable Future by Godfrey Boyle,, Oxford University Press, U.K, 1996.

9. Alternative Energy Sources by Veziroglu, T.N.,,Vol 5 and 6, McGraw-Hill, 1990

10. Biochemical and Photosynthetic aspects of Energy Production by Anthony San Pietro, Academic Press, 1980.

11. Thermochemical processing of Biomass by Bridgurater, A.V., Academic Press, 1981.

12. Renewable Energy by Bent Sorensen, Elsevier, Academic Press, 2011

**Syllabus for B. Tech. IV Year I semester**

**Mechanical Engineering**

**PRODUCTION PLANNING & CONTROL**

(Professional Elective Course**-III)**

**IV Year B.Tech. I-Sem**

**Code: 9B730**

**L T P/D C**

3 **0 0 3**

**Pre-requisites:** NIL

**Course Objectives**:

Understand the importance of Production planning & control. Learning way of carrying out various functions so as

to produce right product, right quanity at right time with minimum cost.

***Course Outcomes:***

*At the end of the course, the student will be able to,*

*CO1: Evaluate production systems and their characteristics to evaluate MRP and JIT systems against*

*traditional inventory control systems and Analyze aggregate planning strategies.*

*CO2: Apply line balancing in production plants*

*CO3: Apply forecast and schedul production systems.*

*CO4: Demonstrate the concepts of Dispatch in PPCand effective management of production systems.*

**UNIT – I:**

**Introduction**: Definition – Objectives of Production Planning and Control – Functions of production planning and control - Types of production systems - Organization of production planning and control department.

**Forecasting:** Definition- uses of forecast- factors affecting the forecast- types of forecasting- their uses - general principle of forecasting. Forecasting techniques- quantitative and qualitative techniques.Measures of forecasting errors.

**UNIT – II:**

**Inventory management:** Functions of inventories – relevant inventory costs – ABC analysis – VED analysis –Basic EOQ model- Inventory control systems –continuous review systems and periodic review systems, MRP I,MRP II, ERP, JIT Systems - Basic Treatment only.

**Aggregate planning –** Definition – aggregate-planning strategies – aggregate planning methods – transportationmodel.

**UNIT –III:**

**Line Balancing**: Terminology, Methods of Line Balancing, RPW method& Largest Candidate method.Routing–Definition – Routing procedure – Factors affecting routing procedure, Route Sheet.

**UNIT – IV:**

**Scheduling:** Definition – Scheduling Policies – types of scheduling methods – differences with loading – flow shop scheduling **–** job shop scheduling, line of balance (LOB) – objectives - steps involved.

**UNIT – V:**

**Dispatching**: Definition – activities of dispatcher – dispatching procedures – various forms used in dispatching.

**UNIT-VI:**

**Follow up**: definition – types of follow up – expediting – definition – expediting procedures-Applications of

computers in planning and control.

**TEXT BOOKS:**

1. Production Planning and Control by M.Mahajan, Dhanpatirai& Co

2. Production Planning and Control by Jain & Jain, Khanna publications

**REFRENCE BOOKS:**

1. Production Planning and Control- Text & cases by SK Mukhopadhyaya, PHI.

2. Production and operations Management by R.PanneerSelvam, PHI

3. Operations Management by Chase, PHI

4. Operations Management by William J. Stevensan, MC Graw Hills.

**Syllabus for B. Tech. IV Year I semester**

**Mechanical Engineering**

**ELECTRIC &HYBRID VEHICLE**

(Professional Elective Course**-III)**

**IV Year B.Tech. I-Sem**

**Code:9B731**

**L T P/D C**

3 **0 0 3**

***Course Outcomes****: At the end of the course, student will be able to*

*1. Explain working of electric vehicles and hybrid electric vehicles.*

*2.Identify motors used for hybrid electric vehicles and Explain their suitability.*

*3.Describe the power converters used in hybrid electric vehicles,*

*4.Demonstrate batteries and other energy storage systems.*

UNIT– I:

Introduction: History of hybrid vehicles, architectures of HEVs, series and parallel HEVs, complex HEVs

UNIT– II

Hybridization of Automobile: Fundamentals of vehicle, components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV; Fuel Cell vehicles and its constituents.

UNIT– III

Plug-in Hybrid Electric Vehicle: PHEVs and EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, PHEV battery charging.

UNIT– IV

Power Electronics in HEVs: Rectifiers used in HEVs, voltage ripples; Buck converter used in HEVs, non-isolated bidirectional DC-DC converter, regenerative braking, voltage source inverter, current source inverter, isolated bidirectional DCDC converter, PWM rectifier in HEVs, EV and PHEV battery chargers

UNIT– V

Battery and Storage Systems Energy Storage Parameters; Lead–Acid Batteries; Ultra capacitors; Flywheels - Superconducting Magnetic Storage System;

UNIT– VI

Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource

Text Books

1. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2014.

2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

Reference Books:

1. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004

**Syllabus for B. Tech. IV Year I semester**

**Mechanical Engineering**

**INDUSTRIAL MANAGEMENT**

**(Professional Elective Course –IV)**

**Code: 9B732**

**L T P/D C**

3 **0 0 3**

**Pre-requisite**: NIL

**Course Objectives:**

• Understand the philosophies of management gurus

• Understand the various types of organization structures and their features, and Their advantages and disadvantages.

• Learning various Industrial Engineering Practices like Operations Management techniques, work study, statistical quality control techniques, Job evaluation techniques and network analysis techniques

***Course Outcomes****:*

*At the end of the course, the student will be able to*

1. *Able to Explain principles of management and design the organization structure*
2. *Able to apply techniques for plant location, design plant layout and value analysis*
3. *Able to carry out work study to find the best method for doing the work and establish standard time for a given method*
4. *Able to prepare a project plan using network analysis.*

**UNIT – I**

**Introduction to Management:** Entrepreneurship and organization – Nature and Importance of Management, Functions of Management, Taylor’s Scientific Management Theory, Fayol’s Principles of Management, Maslow’s Theory of Human Needs, Systems Approach to Management, Leadership Styles, Social responsibilities of Management

**UNIT - II**

**Designing Organizational Structures:** Departmentalization and Decentralization, Types of Organization structures – Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

**UNIT - III**

**Operations Management:** Objectives**-** product design process- Process selection-Types of production system (Job, batch and Mass Production), Plant location-factors- Types of Plant Layouts- Design of product layout- Line balancing (RPW method) Value analysis-Definition-types of values- Objectives- Phases of value analysis- Fast diagram

**UNIT - IV:**

**Work Study:** Introduction, definition, objectives, types of study — steps in work study, Method study — definition, objectives, steps of method study. Work Measurement, purpose, stop watch methods, steps, key rating, allowances , standard time calculations, work sampling.

**UNIT - V**

**Job Evaluation: Methods of job evaluation —** simple routing objective systems — classification method factor comparison method, point method, benefits of job evaluation and limitations.

**UNIT - VI**

**Project Management (PERT/CPM):** Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (simple problems)

**TEXT BOOKS**

1. Industrial Engineering and Management/O.P. Khanna/Khanna Publishers.

2. Industrial Engineering and Management Science/T.R. Banga and S.C. Sarma/Khanna Publishers. **REFERENCE BOOKS**

1. Motion and Time Study by Ralph M Barnes! John Willey & Sons Work Study by lLO.

2. Human factors in Engineering & Design/Ernest J McCormick /TMH.

3. Production & Operation Management /Paneer Selvam/PHI.

4. Industrial Engineering Management/NVS Raju/Cengage Learning.

5. Industrial Engineering Hand Book/Maynard.

6. Industrial Engineering Management I Ravi Shankar/Galgotia.

**Syllabus for B. Tech. IV Year I semester**

**Mechanical Engineering**

**COMPUTATIONAL FLUID DYNAMICS**

(Professional Elective Course – IV)

**Code: 9B733**

**L T P/D C**

3 **0 0 3**

**Pre-requisite**: Heat Transfer and Fluid Mechanics

**Course Objective**: To apply the principles of Heat Transfer and Fluid Mechanics to formulate governing equations for physical problems and to solve them using different numerical techniques

***Course Outcomes****:*

*At the end of the course, the student should be able to*

*CO1: Differentiate between different types of Partial Differential Equations and to apply numerical*

*Techniques along with boundary conditions.*

*CO2: Solve the simple heat transfer and fluid flow problems using different numerical techniques, viz., FDM for heat transfer problems.*

*CO3: Apply the parabolic equations in CFD and validatate of numerical solution in CFD*

**UNIT – I:**

Review of Modes of Heat Transfer – Governing Equations – Initial and boundary conditions

Methods to solve a physical problem –Relative advantages and disadvantages of experimental, analytical and

numerical methods – Scope of CFD – Its applications and limitations - Brief comparison between different

numerical methods, viz., FDM,FEM & FVM Methods to solve a system of simultaneous Linear Algebraic

Equations, - Direct Method – Banded Matrices – Thomas algorithm / TDMA - iterative schemes of Matrix

Inversion.

**UNIT – II:**

Classification of PDE – Elliptic, parabolic and hyperbolic PDE as governing equations – Examples and their

physical significance FDM – Discretization of Partial Derivative Terms using Taylor’s series of approximation – Finite Difference Formulae – Application and implementation aspects of finite-difference equations –Consistency

**UNIT – III:**

Application of FDM to elliptic equations, viz., Laplace Equations – solution of 1D steady state heat conduction

using FDM – Systems with heat generation –Systems with variable thermal conductivity – Fins

**UNIT – IV:**

Application of FDM to solve 1D steady state heat conduction in Curvelinear geometry – Singularities – Treatment of singularities

Application of FDM to solve 2D steady state heat conduction– with and without heat generation and subjected to different boundary conditions

**UNIT – V:**

Parabolic Equations – Use of Explicit, implicit and semi implicit methods – Errors and Stability analysis -

application of FDM to solve 1D transient heat conduction equations – ADI Scheme – Treatment and

Implementation

**UNIT-VI:**

Numerical methods for incompressible flow – Governing equations –Difficulties in solving N-S equations – Stream function and Vorticity method – Advantages and disadvantages – treatment of boundary conditions – Determination of Pressure for viscous flows – Disadvantages – Staggered Grid – SIMPLE algorithm for pressure liked equations.

TEXT BOOKS:

1. Computational fluid dynamics by John D. Anderson Jr. / Mc Graw Hill

2. An Introduction to Computational Fluid dynamics: The finite Volume method by H. Versteeg W. Malalasekara / Pearson

REFERENCE BOOKS:

1.Computational methods for Fluid Dynamics by Joel H. Ferziger & Milovan Peric /Spinger

2. Finite volume methods for Hyperbolic problems by Randall J. Leveque

3. Computational fluid dynamics: A practical approach by Jiyuan Tu et al. / BH publishers

4. Numerical Heat transfer and fluid flow by Suhas V. Patanker

**Syllabus for B. Tech. IV Year I semester**

**Mechanical Engineering**

**UNCONVENTIONAL MACHINING PROCESSES**

**(Professional Elective Course – IV)**

**Code:9B734**

**L T P/D C**

3 **0 0 3**

**Course Outcomes :**

Co1: To distinguish between traditional and non traditional machinery processes along with applications

Co2: To explain ABJ, WJM, AWJM and ECM with line diagram

Co3: To work out metal removal rate due to ED. EBM plasma and chemical machinery processes

UNIT – I Introduction – Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection. Materials. Applications. Ultrasonic machining – Elements of the process, mechanics of metal removal process, parameters, economic considerations, applications and limitations, recent development.

UNIT - II Abrasive Jet Machining, Water Jet Machining And Abrasive Water Jet Machining: Basic principles, equipment, process variable, and mechanics of metal removal, MRR, application and limitations. Electro – Chemical Processes: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring processes, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Simple problems for estimation of metal removal rate.

UNIT – III Thermal Metal Removal Processes: General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.

UNIT – IV Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut.

UNIT - V Application of plasma for machining, metal removing mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries.

UNIT – VI Chemical machining – principle - maskants – applications, Magnetic abrasive finishing, Abrasive flow finishing, Electro stream drilling, shaped tube electrolyte machining.

TEXT BOOKS:

1. Advanced Machining Processes / VK Jain / Allied publishers 2. Modern Machining Processes - P. C. Pandey, H. S. Shan/ Mc Graw Hill

REFERENCE BOOKS:

1. Unconventional Manufacturing Processes/ Singh M.K/ New Age Publishers

2. Advanced Methods of Machining/ J.A. McGeough/ Springer International

3. Non-Traditional Manufacturing Processes/ Benedict G.F./ CRC Press

**Syllabus for B. Tech. IV Year I semester**

**Mechanical Engineering**

**VEHICLE DYNAMICS**

**(Professional Elective Course – IV)**

**Code: 9B735**

**L T P/D C**

3 **0 0 3**

**COURSE PRE-REQUISITES:** Engineering Physics, Mathematics, Engineering Mechanics and Automotive Chassis

**COURSE OBJECTIVES:**

• To identify different vehicle performance parameters

• To provide knowledge on vehicle ride model

• To study vehicle handling characteristics

***COURSE OUTCOMES:***

*After completion of the course, the student should be able to*

***CO-1:*** *Explain vehicle performance parameters and Estimate Braking performance of the vehicle*

***CO-2:*** *Estimate skid, traction,traction and rolling resistance using expressions of Tyre Dynamics*

***CO-3:****Calcualte roadload including aerodynamics loads on the vehicle*

***CO-4:*** *Develop a vehicle ride model and explain the vehicle handling characteristics*

**UNIT – I:**

**Vehicle Performance:** Fundamental approach to modelling - lumped mass, vehicle fixed coordinate system, motion variables, earth fixed coordinate system, Euler angles, forces, newton’s second law, dynamic axle loads - static loads on level ground, low- speed acceleration and loads on grades.

**Acceleration Performance:** Power-limited acceleration-engines, power train, automatic transmissions, traction-limited acceleration - transverse weight shift due to drive torque and traction limits.

**UNIT – II:**

**Braking Performance:** Constant deceleration, deceleration with wind resistance, energy/power, braking forces - rolling resistance aerodynamic drag, driveline drag, grade, brakes - brake factor, tyre-road friction – velocity, inflation pressure, vertical load, brake proportionating, anti-lock braking systems, braking efficiency, rear wheel lockup and pedal force gain.

**UNIT – III:**

**Tyre Dynamics:** Mechanics of pneumatic tyres, tyre forces and moments, rolling resistance of tyres, tractive (braking) effort and longitudinal slip (skid), cornering properties of tyres-slip angle and cornering force, slip angle and aligning torque, camber and camber thrust, performance of tyres on wet surfaces and ride properties of tyres.

**UNIT – IV:**

**Road Loads:** Aerodynamics - mechanics of air flow around a vehicle, pressure distribution on a vehicle, aerodynamic forces, drag components, aerodynamics aids - bumper spoilers, air dams, deck lid spoilers, window and pillar treatments, optimization, drag - air density, drag coefficient, side force, lift force, pitching moment, yawing moment, rolling moment, crosswind sensitivity.

**UNIT – V:**

**Ride:** Excitation sources - road roughness, tyre/wheel assembly, driveline excitation, engine/transmission, vehicle response properties - suspension isolation, suspension stiffness, suspension damping, active control, wheel hop responses, suspension nonlinearities, rigid body bounce/pitch motions and bounce pitch frequencies.

**UNIT – VI:**

**Handling:** Introduction, low speed turning, high speed cornering - tyre cornering forces and cornering equations, understeer gradient, characteristic speed, critical speed, lateral acceleration gain, yaw velocity gain, sideslip angle, static margin, suspension effects on cornering - roll moment distribution, camber change, roll steer, lateral force compliance steer, aligning torque, effect of tractive force on cornering and summery of under steer effects.

**TEXT BOOK:**

1. Fundamentals of Vehicle Dynamics, Thomas D. Gillespie, SAE, USA, 1992

**REFERENCES:**

1. Theory of Ground Vehicles, Wong J. Y., 4th Edition, John Wiley & Sons, USA, 2008

2. Automobile Mechanics, Giri N. K., 10th Edition, Khanna Pub, 2015

**Syllabus for B. Tech. IV Year I semester**

**Mechanical Engineering**

**METROLOGY& INSTRUMENTATION LAB**

**Code: 9B775**

**L T P/D C**

0 **0 3 1.5**

**A: Metrology Lab**

**Pre-requisites: Metrology Theory**

**Course Objective:**

The Metrology and instrumentation Laboratory course is designed for measuring and gauging instruments for inspection of precision linear, geometric forms, angular and surface finish measurements.

**Course Outcomes:**

Student will become familiar with the different instruments that are available for linear, angular, roundness and roughness measurements they will be able to select and use the appropriate measuring instrument according to a specific requirement (in terms of accuracy, etc).

**LIST OF EXPERIMENTS:**

1. Measurement of lengths, heights, diameters by vernier calipers and micrometers
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Use of gear tooth vernier for checking the chordal addendum and chordal height of      spur gear.
4. Thread measurement by Two-wire/ Three-wire method
5. Tool makers microscope and its application.
6. Angle and taper measurements by Bevel protractor and Sine bar.
7. Surface roughness measurement by Taly Surf.
8. Measurement of gear parameters and thread parameters using Profile Projector
9. Measurement of alignment using Autocollimator / Roller set
10. Calibration of Micrometer and vernier caliper using slip gauges
11. Measurement of roundness of cylindrical specimen using dial indicator and V-block
12. Measurement of heights using vernier height gauge

**B:Instrumentation Lab**

**Course Objective:**

The student can learn the measurements with and calibration of instruments. They also understand the machine tool alignment test. Instrumentation lab introduces the students with the theory and methods for conducting experimental work in the laboratory and calibration of various instruments for measuring pressure, temperature, displacement, speed, vibration etc.

**Course Out comes:**

After completion of the experiments in Instrumentation Lab:

1. Student will able to Understand the principle of and working procedure of Linear Variable Differential Transformer (LVDT) for measurement of displacement.

2. Student will able to Understand the Principle of Pressure measurement.

3.Student will able to Understand the Principle of Vibration measurement.

4. Student will able to Understand the Principle of Torque measurement and load cell

5. Student will able to Understand the principle of displacement measurement.

6.Student will able to Understand the principle of Temperature measurement.

**LIST OF EXPERIMENTS:**

1. Calibration of Pressure Gauges

2. Calibration of transducer for temperature measurement.

3. Study and calibration of LVDT transducer for displacement measurement.

4. Calibration of strain gauge for temperature measurement.

5. Calibration of thermocouple for temperature measurement.

6. Calibration of capacitive transducer for angular displacement.

7. Calibration of Load Cells

8. Study and use of a Seismic pickup for the measurement of vibration amplitude of an Engine bed at various loads.

9. Study and calibration of photo and magnetic speed pickups for the measurement of speed

10. Measurement of force using strain gauge based dynamometer

**LIST OF EQUIPMENT**

1. Micro meters
2. Verniercaliper
3. Dial Bore guage
4. Inside Calilper 4"
5. Bevel protractor 150/300mm
6. Sine Bar ( 100mm)
7. Surface Plate (Granite)
8. Slip Gauge set (83 Pieces)
9. Dial Guage 10 mm Range
10. Gear tooth Vernier 0-26 mm
11. Three wire sets
12. Tool maker's micro scope
13. Screw thread plug Gauge Go/NOGO
14. Surface Roughness Tester
15. V-Block

**Syllabus for B. Tech. IV Year I semester**

**Mechanical Engineering**

**COMPUTER AIDED ENGINEERING (CAE) LAB**

**Code: 9B776**

**L T P/D C**

0 **3 1.5**

**Pre-requisites: CAE Theory**

**Course Objectives:**

**Upon completion of this course the students will be able to**

 Execute steps required for analysis of objects by using analysis software

 Select the suitable finite element for different types of problems

 Interpret the results finite element results with different boundary conditions

 Know the data exchange formats for importing and exporting the model

 Understand the CAE software applicability for analyzing structural and thermal problems

**Course Outcomes:**

**After completing the subject, students will be able to:**

1. Select appropriate finite element for solving structural and thermal problems.

2. Correlate mathematical formulation of beams using FE method

3. Analyze Stresses and deflections of trusses and bars under static loading.

4. Analyze Stresses and deflections of thin plates subjected to in-plane loading and solids.

5. Interpret the results after model analysis and transient dynamic analysis

6. Simulate real life structural and thermal problems.

**LIST OF EXPERIMENTS**

1. Analysis using 1D-bar elements. [CO-3]

2. Analysis of simple 2D Trusses [C0-3]

3. Analysis deflection of simple Beams [CO-2]

4. Analysis of Plane stress problems [CO-4]

5. Analysis of axi-symmetric problems [CO-4]

6. Steady state Heat Transfer Analysis of a composite wall and a Fin [CO-6]

7. Evaluation of SFD and BMD of Beams with different loading conditions [CO-2]

8. Analysis of three dimensional FEA [C0-4].

9. Modal Analysis of a Beam. CO-5]

10. Harmonic Analysis of a Beam. [CO-5]

11. Transient Analysis of a Beam [CO-5]

12. Developing a 3-D Model in a modelling software and analyzing it by importing into FEA software[CO-1]

**LIST OF EQUIPMENTS& SOFTWARES:** Software used: ANSYS APDL &ANSYS WORKBENCH

**Syllabus for B. Tech. IV Year II semester**

**Mechanical Engineering**

**COMPOSITE MATERIALS**

**(Professional Elective Course – V)**

**Code: 9B836**

**L T P/D C**

3 **0 0 3**

**Pre-requisites:**  materials and mechanics of solids.

**Course objectives:** Provides the concepts of composite materials. To analyze macro and micro mechanical

behavior of a lamina.

***Course Outcomes:***

*At the end of course students will be able*

*CO1: explain types and applications of composites.*

*CO2: Select Reinforcements in composites to improve mechanical properties.*

*CO3: Analyze macro properties of composite lamina and macro properties of composite laminate*

*CO4: Explain Failures of composites and the Joining methods of composites*

**UNIT-I: Introduction to Composite Materials**: Introduction ,ClassificationPolymer Matrix Composites, Metal Matrix

Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and naturemade composites, and applications .

**UNIT-II:Reinforcements:** Fibers- Glass, Silica, Kevlar, carbon, boron, siliconcarbide, and borncarbidefibers. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

**UNIT-III:Macro mechanicalAnalysis of a Lamina**: Introduction, Definitions Stress, Strain, ElasticModuli, StrainEnergy.Hooke’s Law for Different Types of Materials, Hooke’s Law for a Two-DimensionalUnidirectional Lamina, Angle of lamina, Plane Stress Assumption, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina.

**UNIT-IV:Macro mechanical Analysis of Laminates**: Introduction, Laminate Code, Stress–Strain Relations for a Laminate,In-Plane and Flexural Modulus.

**UNIT-V:Failure Analysis of Laminates**: Introduction, Special Cases of Laminates, Applications, Failure Criterion for a Laminate.

**UNIT-VI:Joining Methods and Composite Tests** :Joining –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures.

**Text Books:**

1. R. M. Jones, Mechanics of Composite Materials, McGraw Hill Company, New York, 1975.

2. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.

**Reference Books:**

1. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley- Interscience, New York, 1980.

2. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), By Autar K. Kaw, Publisher:

CRC

3. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.

**Syllabus for B. Tech. IV Year II semester**

**Mechanical Engineering**

**JET PROPULSION and ROCKET ENGINEERING**

**(Professional Elective-V)**

**Code: 9B837**

**L T P/D C**

3 **0 0 3**

**Pre-requisites:** Applied Thermodynamics

**Course Objectives:**

*To make the student aware of various propulsion devices and use of thrust equations.*

*To make the student to know the working of Ramjet engine in detail.*

*To make the student to understand the working of rocket engine and detail study on fuels used in rocket*

. **Course Outcomes:**

After completing the subject, students will be able to:

1.Differentiate open, closed and semi closed cycle of gas turbines, thermal jet engines, classification of energy flow, trust power and propulsion efficiency

2.Evaluate essential components of turbo pro and turbo jet in terms of thrust augmentation

3.Draw plant layout of Ramjet along with the demonstration of principle of operation,

4. Illustrate liquid propellant Rocket engines, cryogenics, propulsion systems, Electrical Nuclear and Plasma Arc propulsion.

5.understand flight mechanics, applications of trust profiles, rocket heat transfer and ablative to cooling

**UNIT-I**

Elements of Gas Turbine theory – Thermo dynamic Cycles, open closed and semi-closed – Parameters of performances – Refinements to simple cycle

**Jet Propulsion:** Historical sketch – Reaction Principle – Essential features of propulsion devices – Thermal Jet Engines, Classification of – Energy flow, thrust, thrust power and propulsion efficiency – Need for Thermal jet engines and applications.

**UNIT – II**

**Turboprop and Turbojet** – Thermo dynamic cycles, Plant layout, essential components, principles of operation – performance evaluation – Thrust Augmentation and Thrust reversal – Contrasting with Piston Engine Propeller plant.

**UNIT – III**

**Ramjet** – Thermo dynamic Cycle, plant lay-out, essential components – Principle of operation – performance evaluation – Comparison among atmospheric thermal jet engines – elementary treatment of Scram jet and pulse jet.

**UNIT – IV**

**Rocket Engines:** Need for, applications – Basic principle of operation and parameters of performance – Classification, solid and liquid Propellant rocket engines, advantages, domains of application – Propellants – Comparison of propulsion systems.

**UNIT – V**

**Rocket technology-I:** Flight mechanics, Application Thrust Profiles, Acceleration – staging of Rockets, need for – Feed systems, injectors and expansion nozzles – Rocket heat transfer and ablative cooling

**UNIT – VI**

**Rocket technology-II** – Testing and Instrumentation – Need for Cryogenics – Advanced Propulsion Systems, elementary treatment of Electrical Nuclear and Plasma Arc Propulsion.

**TEXT BOOKS:**

1. Fundamentals of I.C. Enginers/Gill, Smith and Zierys
2. Rocket Propulsion / Sutton
3. Gas Turbines/V.Ganesan/TMH
4. Thermodynamics of Propulsion / Hill and Paterson

**REFERENCE BOOK:**

1. Gas Turbines / Cohen, Rogers and SarvanaMuttoo / Addison Wesley and Longman
2. Compresssible fluid flow by Yahya

**Syllabus for B. Tech. IV Year II semester**

**Mechanical Engineering**

**MECHATRONICS**

**(Professional Elective-V)**

**Code: 9B838**

**L T P/D C**

3 **0 0 3**

**Pre-requisites:** CAD/CAM

**Course Objective:**

to model and analyze electrical and mechanical systems and their interconnection for engineering applications.

***Course Outcomes:***

*Student will be able to*

*1. integrate of mechanical, electronics, control and computer engineering*

*2. explain the complete working and characteristics of sensors.*

*3. select appropriate actuators for different applications.*

*4. build linear models of mechatronics*

*5. program of microcontrollers with PLC*

**UNIT-I:Introduction:** History of Mechatronics, Scope and Significance of Mechatronics systems, elements of mechatronic systems, needs and benefits of mechatronics in manufacturing Sensors: classification of sensors basic working principles, Displacement Sensor - Linear and rotary potentiometers, LVDT and RVDT, incremental and absolute encoders. Strain gauges. Force/Torque – Load cells. Temperature – Thermocouple, Bimetallic Strips, Thermistor, RTD

**UNIT-II:**Accelerometers, Velocity sensors – Tachometers, Proximity and Range sensors – Eddy current sensor, ultrasonic sensor, laser interferometer transducer, Hall Effect sensor, inductive proximity switch. Light sensors – Photodiodes, phototransistors, Flow sensors – Ultrasonic sensor, laser Doppler anemometer tactile sensors – PVDF tactile sensor, micro-switch and reed switch Piezoelectric sensors, vision sensor

**UNIT-III :**Actuators: Electrical Actuators : Solenoids, relays, diodes, thyristors, triacs, BJT, FET, DC motor, Servo motor, BLDC Motor, AC Motor, stepper motors. Hydraulic & Pneumatic devices – Power supplies, valves, cylinder sequencing. Design of Hydraulic & Pneumatic circuits. Piezoelectric actuators, Shape memory alloys.

**UNIT-IV:** Basic System Models & Analysis: Modelling of one and two degrees of freedom Mechanical, Electrical, Fluid and thermal systems, Block diagram representations for these systems. Dynamic Responses of System: Transfer function, Modelling Dynamic systems, first order systems, second order systems.

**UNIT-V:**Controllers: Classification of control systems, Feed back, closed loop and open loop systems, Continuous and discrete processes, control modes, Two step Proportional, Derivative, Integral, PID controllers.

**UNIT-VI:**PLC Programming: PLC Principles of operation PLC sizes PLC hardware components I/O section Analog I/O section Analog I/O modules, digital I/O modules CPU Processor memory module Programming. Ladder Programming, ladder diagrams, timers, internal relays and counters, data handling, analogue input and output. Application on real time industrial automation

**Reading:**

1. W. Bolton, “Mechatronics‟, 5 thedition, Addison Wesley Longman Ltd, 2010

2. DevdasShetty& Richard Kolk “Mechatronics System Design”, 3rd edition. PWS Publishing, 2009.

3. Alciatore David G &Histand Michael B, “Introduction to Mechatronics and Measurement systems”, 4th edition, Tata McGraw Hill, 2006.

Video references:

1. <http://video_demos.colostate.edu/mechatronics>

2. http:// mechatronics.me.wisc.edu

**Syllabus for B. Tech. IV Year II semester**

**Mechanical Engineering**

**ALTERNATIVE FUELS**

**(Professional Elective-V)**

**Code:9B839**

**L T P/D C**

3 **0 0 3**

**COURSE PRE-REQUISITES:** Engineering Chemistry and Automotive Engines

**COURSE OBJECTIVES:**

• To identify various sources of alternative fuels for SI and CI engines

• To know the benefits and engine modifications required for using alternative fuels

• To provide the quality standards, regulations and third-party inspection for alternative fuel vehicles

***COURSE OUTCOMES:***

*After completion of the course, the student should be able to*

***CO-1:*** *Explain hydrogen as Alternative fuel for IC engines*

***CO-2:*** *Demonstrate the CNG and LNG engines*

***CO-3:*** *Explain the working of LPG engines and LPG standards*

***CO-4:*** *Explain the role of Biogas, methonal and Ethonal and biodiesel*

***CO-5:****Estimate the performance of engines with synthetic Alternative fuels.*

**UNIT – I:**

**Hydrogen:** Properties, production, on-board storage, material compatibility, stationary storage, piping, dispensing, transportation, advantages and disadvantages, safety, standards, usage in IC engines and emissions.

**Liquid Hydrogen:** Properties, production, advantages and disadvantages, hazards, storage, transportation, piping, dispensing and emissions.

**UNIT – II:**

**Compressed Natural Gas:** Production, properties, storage, piping, advantages and disadvantages, dispensing, transportation, material compatibility, CNG fuel kits, engine modifications for CNG operations, CNG combustion, stoichiometric vs. lean burn CNG engines, engine optimization, vehicle emission, after treatment of exhaust, fueling station safety systems, CNG standards and regulations and third-party inspection for alternative fuels vehicles.

**Liquefied Natural Gas:** Production, properties, economics, advantages and disadvantages, transportation, storage, piping, dispensers, LNG to CNG conversion system, regulations for LNG, vehicle performance characteristics and emission.

**UNIT – III:**

**Liquefied Petroleum Natural Gas:** Production, properties, storage, dispensing and receptacles, material compatibility, piping, safety systems, transportation, advantages and disadvantages, LPG engine developments, LPG fuel kits, combustion, emissions and LPG Standards.

**Landfill Gas or Marsh Gas:** Production, properties, composition, monitoring pretreatment, usage, advantages and disadvantages, emissions and applications.

**UNIT – IV:**

**Biogas or Biomethane:** Production, composition, properties, biogas plants, treatment, storage, dispensing, advantages and disadvantages, hazards, emissions and regulations. **Methanol:** Properties, production, applications, advantages and disadvantages, hazards, economics, storage, dispensing, combustion and emissions.

**Ethanol:** Properties, production, dry milling, material compatibility, storage, transportation, piping, dispensing, advantages and disadvantages, hazards, blends, engine modifications, combustion, emissions and standards.

**UNIT – V:**

**Straight Vegetable Oils:** Feedstock selection, iodine value, properties, production, degumming, storage, dispensing, material compatibility, advantages and disadvantages, engine modifications, combustion, emissions and standards.

**Biodiesel:** Feedstock selection, raw material, properties, production, storage, dispensing, material compatibility, standards, transportation, advantages and disadvantages, hazards, engine modifications, combustion and emissions.

**UNIT – VI:**

**Synthetic Alternative Fuels:** Properties, composition, production, storage, engine modifications, blends, combustion, performance and emission characteristics in SI and CI engines, advantages and disadvantages of HCNG and hythane, dimethyl ether, diehyl ether, syngas, plastic fuel and tyre pyrolysis oil.

**TEXT BOOK:**

1. Alternative Fuels, Thipse S. S., Jaico Publishers, 2010

**REFERENCES:**

1. A Textbook of Alternative Fuel of Automobile Engine, Rami Reddy and Yousuf, Front line Publishers

2. Powering Your Vehicle with Straight Vegetable Oil, Forest Gregg